

Rebuilding After Disaster: An Examination of Refugee Camp Design in Jordan

**An Honors Thesis (LA 404)**

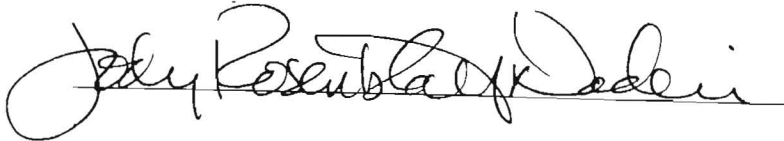
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A handwritten signature in black ink, reading "Jody Rosenblatt-Naderi", written over a horizontal line.

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## Abstract

This project examines refugee camp design for the people displaced by the Israel-Palestine conflict who are now residing in Jordan. In the past, refugee communities have had little or no formal design; however, by utilizing the principles of landscape architecture, these populations can build their communities in ways that have the potential to empower and promote community vitality. Well-designed communities encourage responsible stewardship of land, greater human health, and quicker economic recovery.

This project develops a framework for planning a healthy refugee community and an example application of that framework to the landscape near Amman, Jordan. The framework addresses cultural concerns specific to the Palestinian community, local climate and landscape, eco-balanced community design, and development strategies.

The example addresses the hypothetical application of the framework to the landscape near Amman, showing a case study of how a community might use the recommendations from the framework.

The political and economic atmosphere of the region makes the care of refugee populations precarious; it is

hoped that thoughtful and more sustainable design will help alleviate some of the pressures refugee communities place on their host countries while promoting better health, improved economic growth, and stronger community networks for the refugee community.

## Acknowledgements

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# **Rebuilding After Disaster**

An Examination of Refugee Camp Design in Jordan

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## Introduction

Organized humanitarian aid developed relatively recently in human history. The eighteenth century saw an increased awareness of human suffering due to industrialization, slavery, and global exploration. As a result, there has been a variety of attempts to improve humanitarian response over the decades. Refugee camps emerged as one of the earliest methods used to address the needs of large numbers of refugee populations.

When discussing humanitarian aid, it's common to hear the proverb, "If you give a man a fish he'll eat for a day. If you teach him to fish he'll eat for a lifetime." This romantic concept assumes that refugees are refugees because they lack the skills they need to survive. Little thought is given to the environment in which people are trying to survive. After all, what good is fishing if there's nowhere to fish or if the water is too polluted or dangerous to access?

Disaster situations make basic needs such as food, water, and shelter elusive and sporadic. Organizers of refugee camps attempt to provide for these and other needs to a large group of people who have been displaced by disaster or conflict. In addition to the basic needs common to all displaced people, each refugee population has

concerns specific to the population's culture, history, and expectations that need to be considered when building their communities.

When one begins examining the conditions of the refugee camps, it's not surprising that so many people are trapped in the camp lifestyle with few opportunities to improve their situations. Land and resource management is just as central to disaster recovery as the initial aid packages of food, water, and shelter. In fact, land management may prove to be the most important step in disaster recovery in the long term.

This study examines the problem of land management within refugee communities and the consequences that poor management has on refugee populations. From that analysis comes a list of goals designers should keep in mind when developing refugee communities. These goals shape the framework for an "ideal" method for planning and designing refugee communities. Finally, the framework is applied to a hypothetical Palestinian refugee community near Amman, Jordan, for examination.

### Brief History of the Israeli-Palestinian Conflict

Around the turn of the nineteenth century, a new ideological movement was taking hold in many European Jewish communities. Dubbed "Zionism," this movement

recalled the Jewish belief that the Jews would be restored to their ancestral homeland in what was then Ottoman Palestine. This ideological movement quickly became a political movement. Jewish migration to the area of Palestine, which had been going on since the late nineteenth century, steadily increased with the rise of anti-Semitism in Europe and much of Asia. After World War I, the British gained control of Ottoman Palestine, which then became called the British Mandate of Palestine.

While tensions between Palestinians and Zionists had been escalating through World War I, the first deadly clashes between Jewish settlers and Arab Palestinians occurred as early as 1920 (Tessler 165). Tensions continued to increase, and by the end of World War II, the British government handed over the conflict to the United Nations, which proposed splitting the territory in two pieces—one for the Jewish population and one for the Palestinian population. The Palestinians and supporting Arab countries rejected this proposal, while the Jews accepted it. Despite the disagreement, on 14 May 1948, the State of Israel was declared. The following day, Arab armies from Egypt, Jordan, Lebanon, Syria, and Iraq invaded Israel, marking the first Arab-Israeli war. Israel was victorious and gained much more territory than the United Nations had





Figure 1: Israel and the occupation of the Palestinian Territories (Seljan)

originally recommended. As part of the new arrangement, Jordan assumed control of the West Bank, and Egypt assumed control of the Gaza Strip (Figure 1: Israel and the occupation of the Palestinian Territories).

Since 1948, over a half-dozen other major conflicts have occurred between Israel and its Arab neighbors (Figure 2: Timeline of the Israel-Palestine Conflict). These and many other lesser-known conflicts have caused wave after wave of Palestinian refugees to seek safety in neighboring countries. There are now over 4.8 million refugees registered with United Nations Relief and Works Agency (UNRWA), making the Palestinian

refugee population the largest in the world (European Union). It has also become the longest lasting refugee population in the world, with unprecedented third- and fourth-generation refugees.

With the refugee situation spiraling out of control, the United Nations created the Relief and Works Agency in 1949 as the agency that would respond directly to the Palestinian refugees' needs (United Nations, Overview). Unlike other UN bodies, UNRWA operates autonomously, with only limited assistance from local governments and organizations. UNRWA administers the camps and builds schools, clinics, and

housing for the refugees. It remains the main aid agency responsible for the Palestinian refugee population, operating camps in Jordan, Syria, Lebanon, the West Bank, and Gaza (Figure 3: Refugee Camp Locations). It provides "assistance, protection, and advocacy" for the registered refugees in these areas (United Nations, Where UNRWA Works).

### Current Situation

Over 40% of registered Palestinian refugees – or two million individuals – now live in Jordan; 20% live in UNRWA official camps (Figures 4 and 5). Of the thirteen total refugee camps in Jordan, ten are official:

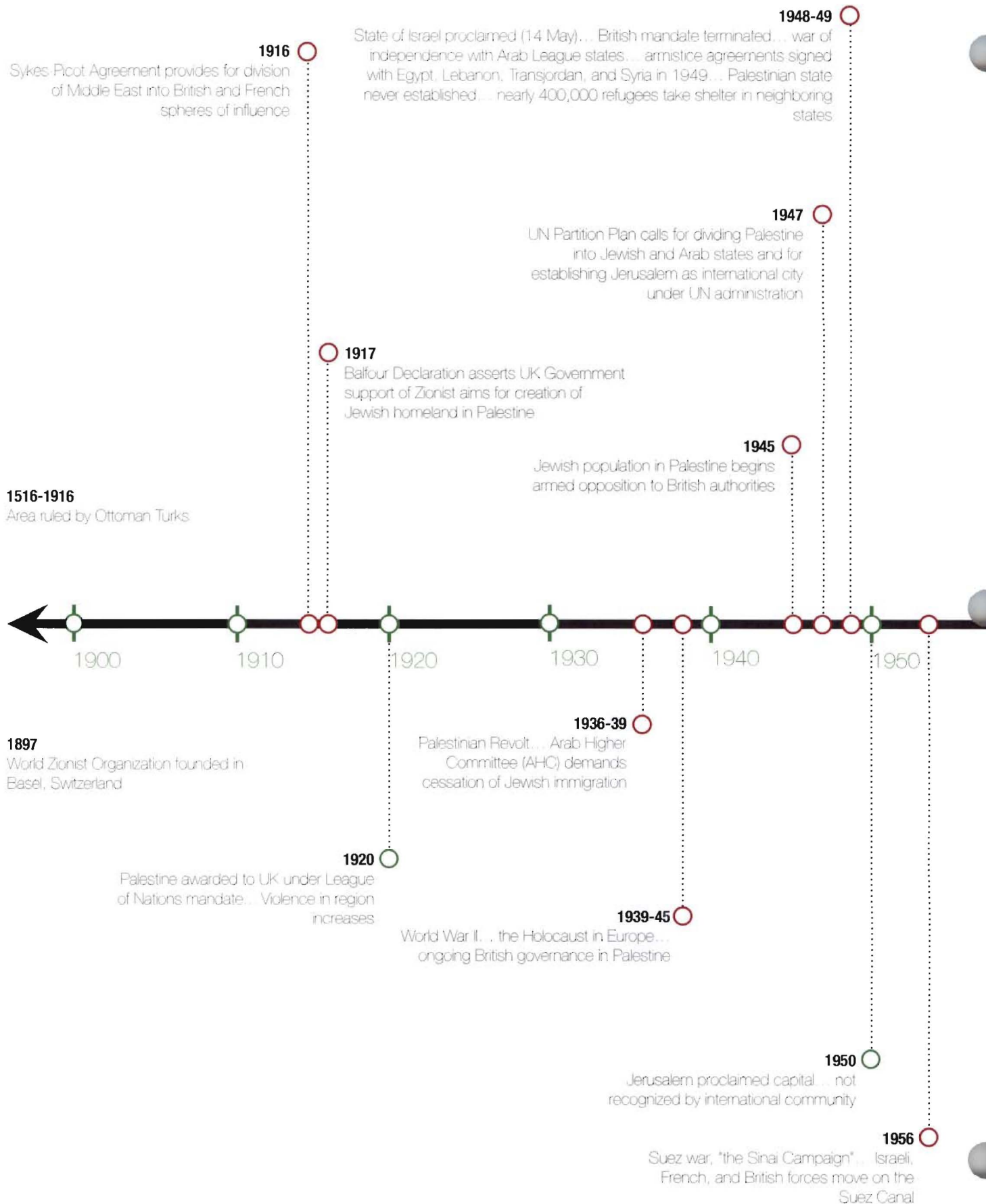
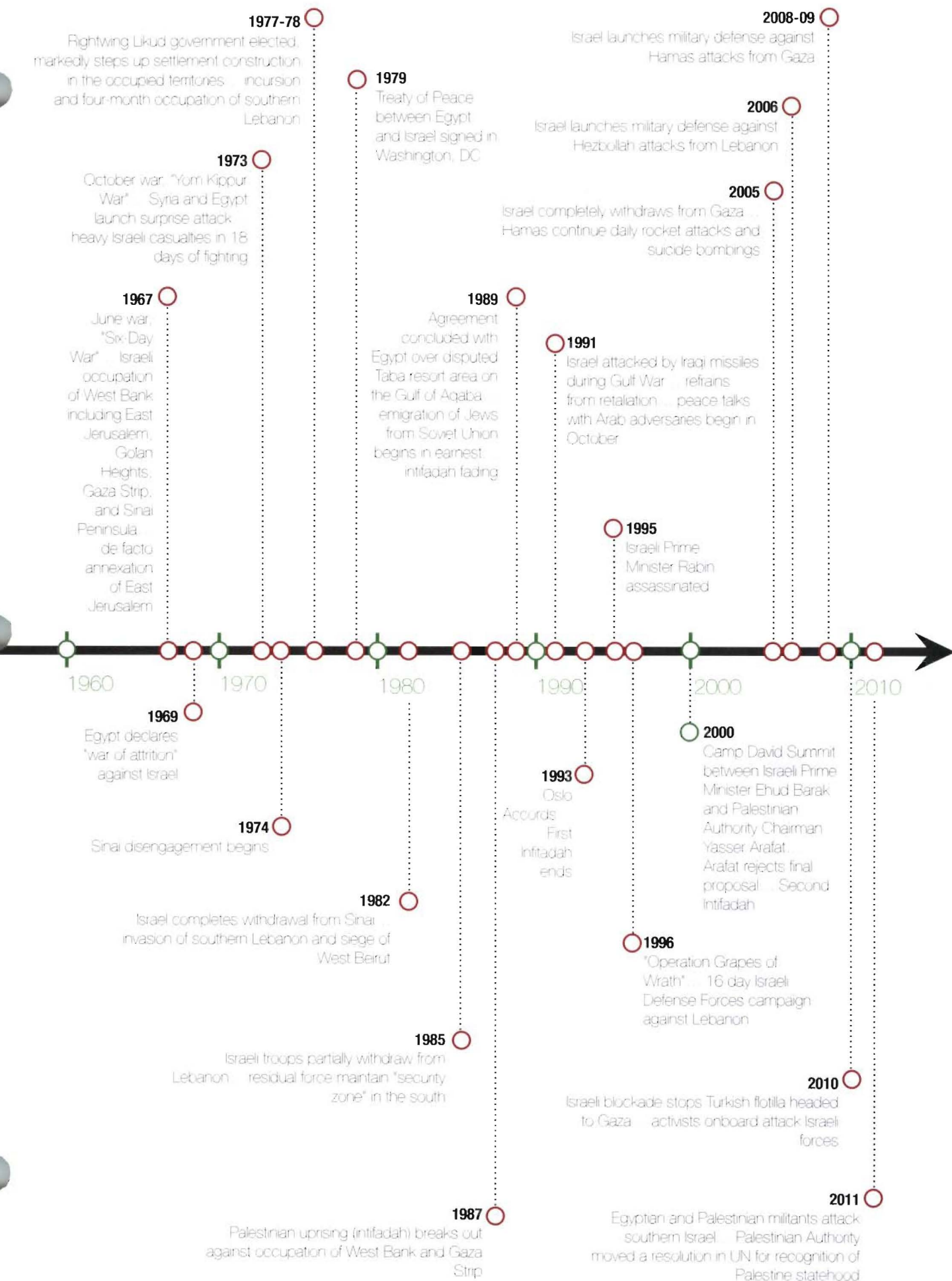


Figure 2: Time Line of the Israel-Palestine Conflict (Tessler)





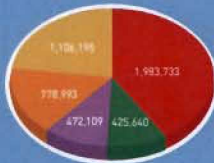


unrwa  
الأونروا

Peace  
Starts Here

## Fields of operation

### REGISTERED REFUGEES (by country)\*



Total: 4,766,670

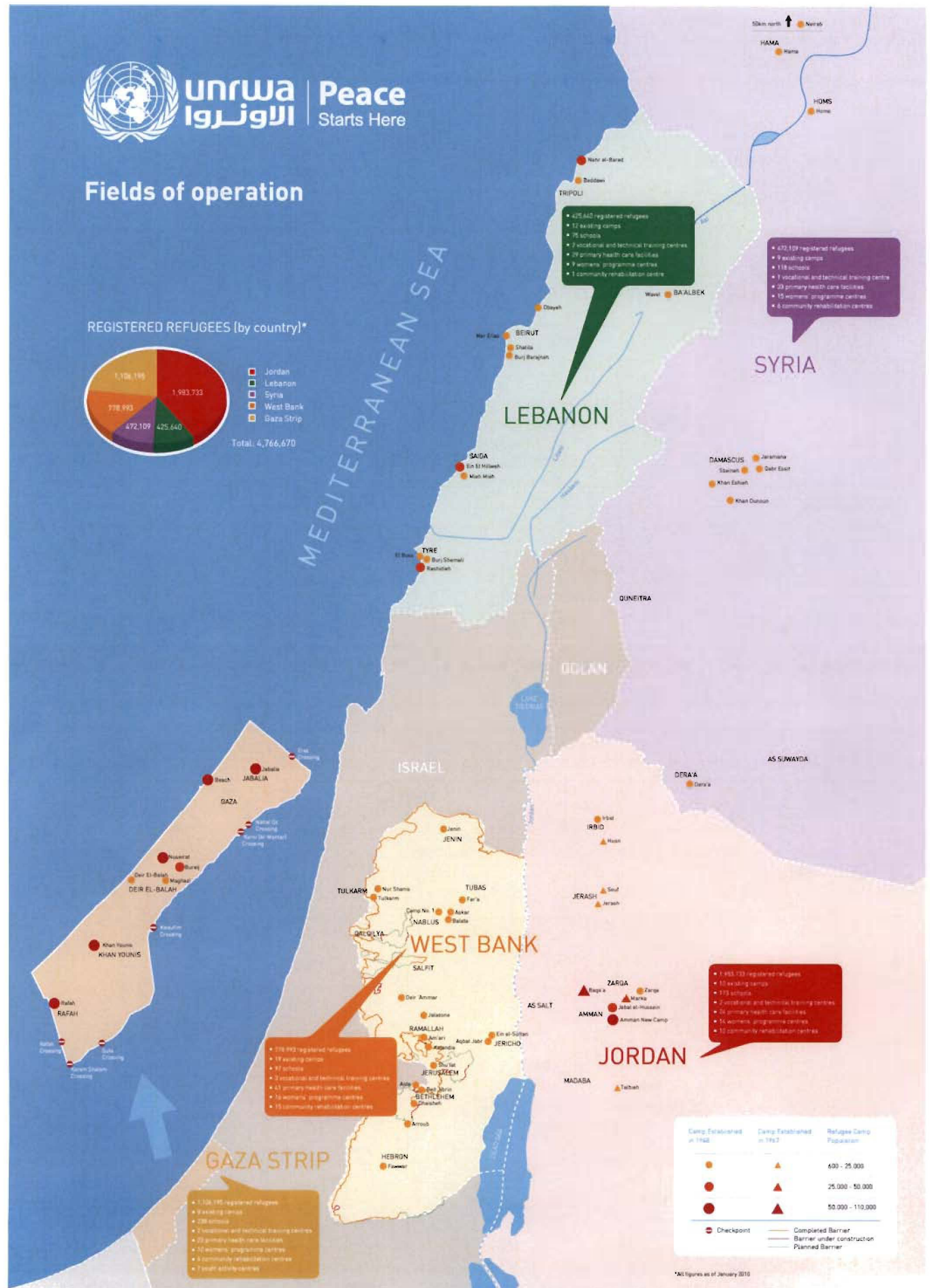


Figure 3: Refugee Camp Locations (United Nations, UNRWA Field of Operations)



- Amman New Camp (also called “Wihdat”)
- Baqa’a
- Husn
- Irbid
- Jabal el-Hussein
- Jerash
- Marka
- Souf
- Talbeih
- Zarqua

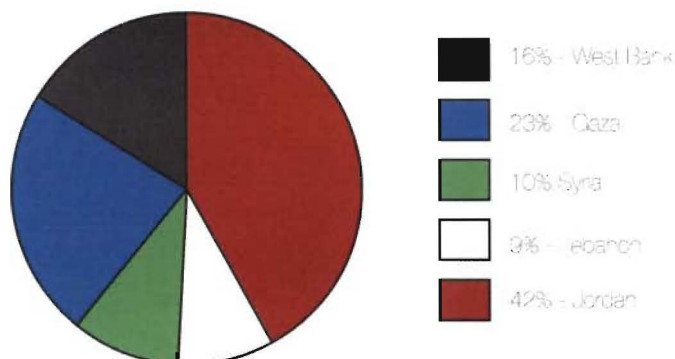


Figure 4: Distribution of Palestinian Refugees (United Nations, *Jordan*)

Among all the camps, over half of camp residents are under the age of twenty-five (Figure 6: *Camp Refugee Ages*).

According to Arneberg’s research at the Fafo Institute for Applied Social Science, residents suffer from (25-28):

- Overcrowded conditions
- Early marriage and divorce
- Poverty and unemployment
- Lack of access to green areas and open play spaces
- Poorly constructed shelters
- Inadequate access to healthcare facilities
- Poor sanitation and hygiene facilities

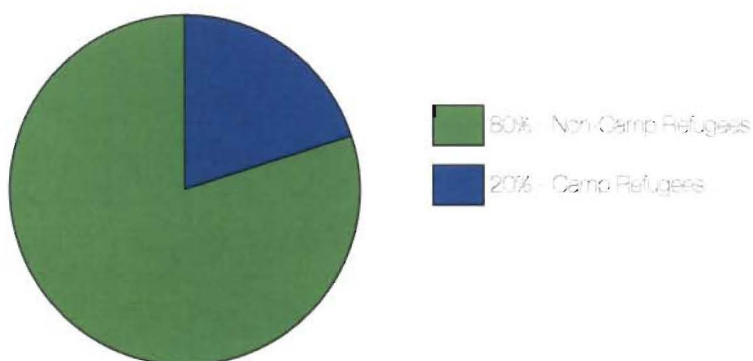


Figure 5: Distribution of Palestinian Refugees in Jordan (United Nations, *Jordan*)

While Palestinian refugees living in Jordan have full Jordanian citizenship, with some exceptions (United Nations, *Jordan*), a lack of funds contributes to crowded school systems (run by UNRWA), unmet medical needs, and outdated infrastructure. However, despite these challenges, students who study in UNRWA schools perform “well above the average,” and

refugees do have access to micro-credit programs that are designed to encourage entrepreneurship and small businesses (United Nations, *Jordan*). Figure 7: *Camp Profiles* summarizes the institutional composition of each camp. Nearly every camp includes at least one health center, rehabilitation center, women’s program center, and a food distribution center. Additionally,

some camps include an environmental health office, a camp development office, or a kindergarten/nursery.

It is also worthwhile to examine camp densities and the number of children per school. According to available data, the original refugees were packed into the camps at a density of about 250 people per hectare (United Nations, *Jordan*).

Camp populations range from a few thousand to over 100,000, making many refugee camps medium-sized cities. Likewise, UNRWA averages about 950 children per school, though some schools have many more children than that. Noticeably absent from all the refugee camps are higher education opportunities, either colleges or technical schools. Though students are performing, on average, better than their non-refugee counterparts, there is little indication these students are offered higher learning opportunities.

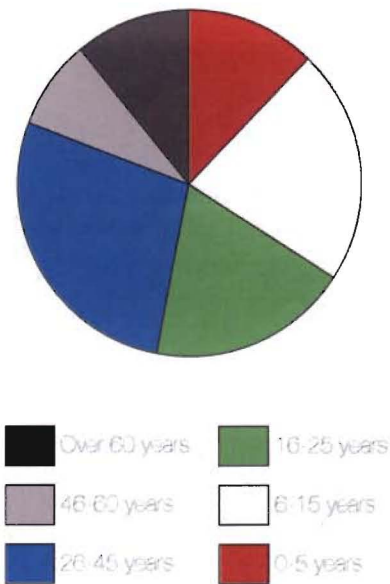
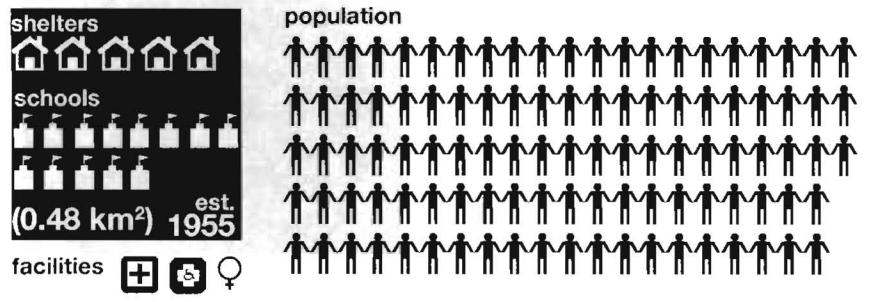
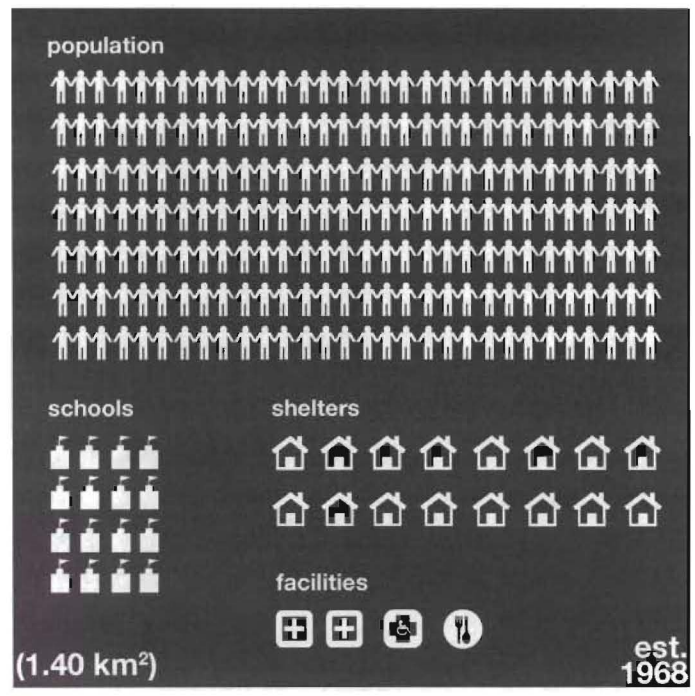


Figure 6: Camp Refugee Ages (United Nations, Jordan)

# 1/ Amman New Camp (Wihdat)



## 2/ Baqa'a



## 3/ Husn

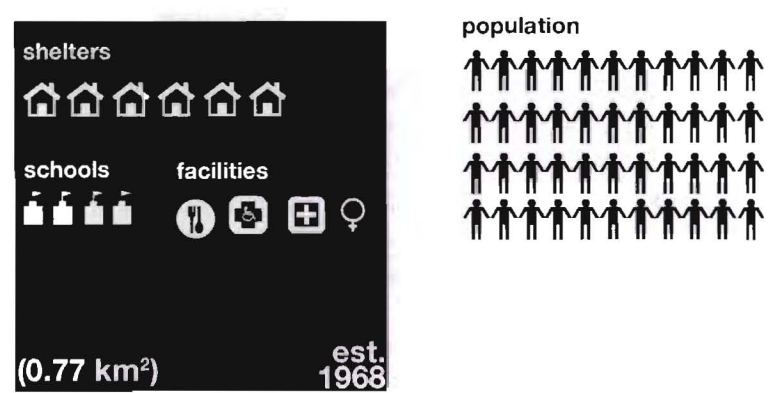
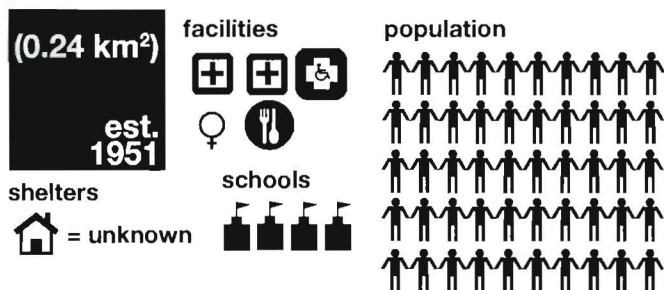
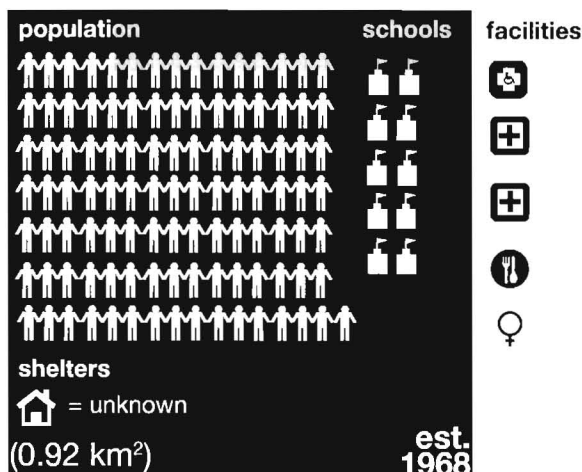


Figure 7: Camp Profiles (United Nations, Jordan)

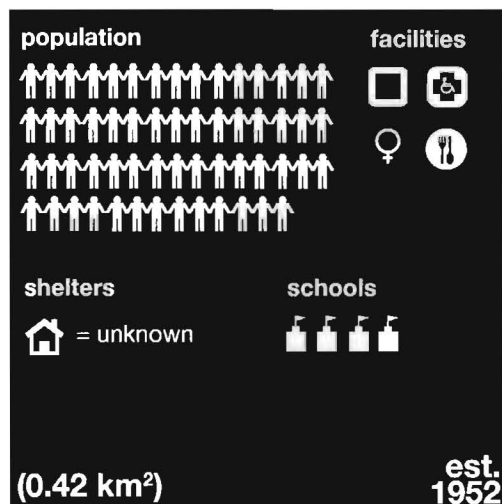
## 4/ Irbid



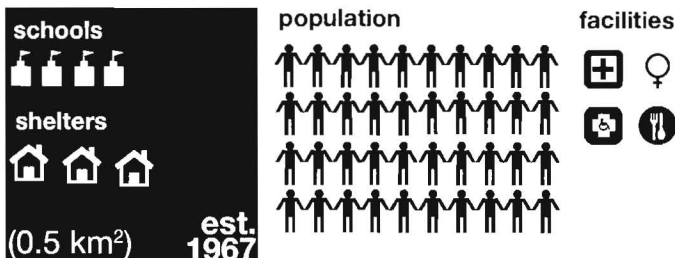
## 7/ Marka (Hitten)



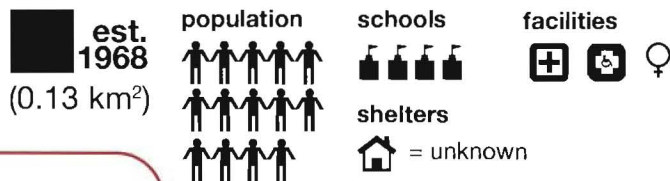
## 5/ Jabal el-Hussein



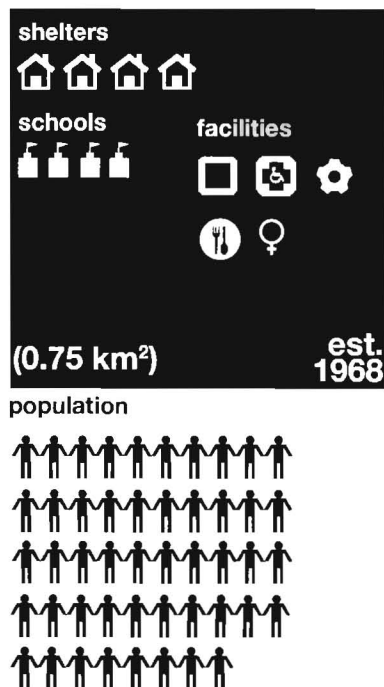
## 8/ Souf



## 9/ Talbeih



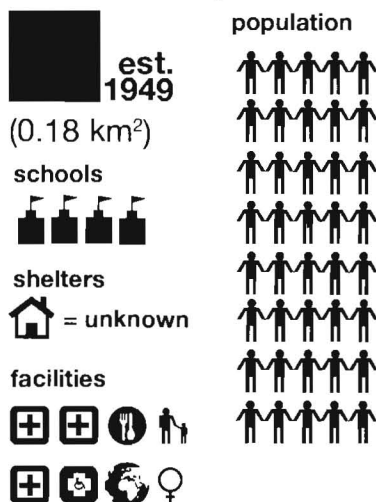
## 6/ Jerash (Gaza Camp)



### Key

- Camp Area
- 500 People
- 500 Shelters
- School
- Health Center
- Rehabilitation Center
- Women's Program Center
- Food Distribution Center
- Camp Development Office
- Environmental Health Office
- Kindergarden/Nursery

## 10/ Zarqua





## Problem Statement

This research explores the possibilities for designing Palestinian refugee camps in Jordan. Waste and water management techniques, local design customs, eco-balanced communities, and community-building strategies will also be examined. The end products of this research are a framework for creating sustainable, healthy refugee communities, and an example application of the framework to a refugee community in Amman, Jordan.

### Sub-problems:

- a) What are different waste and water management techniques that can be used in Jordan?
- b) What are the design customs of the Levantine culture?
- c) How can landscapes be ecologically balanced to provide for a community's needs?
- d) What are successful design strategies for building communities within refugee neighborhoods?

### Hypotheses:

- a) Waste and water management techniques that can be used will include well systems, rainwater harvesting, and water reclamation.
- b) Traditional Levantine architecture will feature enclosing walls and open-air courtyards. Building materials will include earth and stone, though brick and concrete might also be prevalent.
- c) Landscapes will be balanced among productive, natural, and developed land uses.
- d) Design strategies for building communities include supporting medical facilities, encouraging educational facilities, and providing recreational facilities. Paying attention to the creation of community gathering areas will also be especially important.

### Delimitations:

- a) This study will not address the political concerns surrounding the Palestinian Question in Jordan.
- b) This study will not provide funding solutions.
- c) This study will not include detailed architectural designs for the buildings.

### Assumptions:

- a) The ongoing conflict in Israel and the Occupied Palestinian Territories will continue to displace people who will likely become refugees in Jordan and surrounding countries. Likewise, the conflict will continue to prevent most current refugees from resettling to a recognized, permanent location.
- b) Project sites will be available.
- c) There is an interest in creating healthier communities for refugee populations in Jordan.
- d) The basic principles of community design are applicable to refugee camp design.

## Project Significance

As millions of Palestinian refugees have fled their homeland, surrounding countries and international aid organizations struggle to meet the refugees' housing, community, and nutritional needs. Jordan in particular has been receiving large numbers of refugees since the 1940s.

This proposal is significant because as the refugee population continues to grow, responsible design can be employed to create healthier living and social conditions that could promote resettlement and rehabilitation, thus reducing the numbers of refugees who are dependent on national and international aid. Additionally, these communities can increase their independence from their hosts by drawing fewer resources and by contributing more to the economy.

Because of the implications of reducing the refugee population and of caring more effectively for the refugees, this proposal is particularly significant to landscape architects, aid workers, and community designers who are trying to accommodate large influxes of refugee populations around the world.

Review of Literature

Water and Wastewater Management Techniques

Communities in semi-arid climates struggle to obtain enough clean water. Ideally, camps should plan for at least 20-50 liters of water per person per day for basic personal needs (United Nations, UN-Water); however, residents of Jordan use an average 85 liters (0.085 m³) per person per day—the lowest usage in the region (Tarawneh and Kadioglu 123). In order to obtain these quantities of water in an arid community, a water conservation and collection system must be put into place. The type of system a refugee community might choose varies from place to place, depending on local conditions. For instance, in an area with a sufficiently high water table and little space, wells may be appropriate; other times, if there is enough precipitation, a rainwater harvesting system can be

appropriate, as long as it is fully integrated into the community without breaking up spaces (Lizzaralde, Johnson, and Davidson 212). The water system should be designed to blend with the community and be used as an architectural and visual element within the community.

When designing a comprehensive water management system, it's important to consider the community's water sources. These may include rainwater, groundwater, grey water, and/or sewage, among other sources (Washington, *Onsite Wastewater*). According to a study on precipitation climatology, "water resources in Jordan mainly depend on precipitation" (Tarawneh and Kadioglu 123). Since the region already pumps groundwater at unsustainable rates, new communities should be designed to rely mainly on harvested rainwater ("Jordan's Water Shortage"). To maximize the use of all

harvested water, the water management system should also reclaim and treat used water. The combination of rainwater harvesting with water reclamation provides the most reliable water source in the Amman region. Even so, a rainwater harvesting system is highly vulnerable to drought, a problem that has recently plagued the region (Antelava). Because of this concern, the community must have an emergency water system. Adding an emergency well system or planning for emergency water delivery would provide additional layers of resilience should there be prolonged periods of drought. Implementing best practices in minimizing water use further strengthens the system.

The area around Amman, Jordan, receives between 270 and 350 millimeters of rainfall annually, mostly during the winter months (Tarawneh and Kadioglu 125). Though communities

	Membrane Bio-Reactor (MBR)	Activated Sludge	Rotating Biological Contactor (RBC)	Living Machine
Preliminary	Screening			
Primary	Flow equalization tank			
Secondary	Membrane Bio-Reactor	Sedimentation Basin		Biofilter
		Mixing Reactor & Reintegrated Sludge	Biological Contactor	Anoxic Reactor
		Final Clarifier	Final Clarifier	Aerobic Reactor
Tertiary	Constructed Wetland			
	UV/Ozonation/Chlorination Disinfection			

Figure 8: Onsite Wastewater Treatment Processes (Washington, "Treatment")



System Type	Advantages	Disadvantages
<b>Membrane Bio-Reactor</b>	Most compact system Most scalable to future capacity Fully automated/ low maintenance	Higher level of operator training
<b>Activated Sludge</b>	Most common system type	Higher energy use for mixing
<b>Rotating Biological Contactor</b>	Accepts highest pollutant load	Higher energy use for treatment Potential for odor/noise
<b>Living Machine</b>	Visual Amenity- can be showcased Quiet and low-cost operation	High level of maintenance Larger footprint/ system size

Figure 9: Advantages and Disadvantages of Treatment Technologies (Washington, “Advantages”)

can meet their water needs harvesting rainwater, certain costs associated with storing and cleansing the collected water need to be considered. A variety of water cisterns would have to be constructed to store the community's water over the drier summer months. Communities may economically construct smaller cisterns out of recycled barrels and other “found” containers, as seen in the San Felipe case study on page 38. These small-scale efforts certainly reduce the overall need for water storage, but water independence justifies investment in larger water cisterns for the community.

Onsite water treatment delivers many benefits to communities. It has the potential to reduce water consumption in buildings by 48-95% and can reduce the discharge of wastewater by 60-95% (Washington, *Onsite*), which means much lower burdens to the

community for obtaining sufficient water and lower costs to the host country and municipality for proper water treatment. Benefitting from the economies of scale, the refugee community could utilize one of several onsite water treatment systems: membrane bio-reactor system (MBR), activated sludge system, rotating biological contactor system (RBC), or a living machine system (Washington, *Onsite*). All of these systems use biological agents to cleanse and purify water, as demonstrated in Figure 8: *Onsite Wastewater Treatment Processes*.

Figure 9: Advantages and Disadvantages of Treatment Technologies shows that the treatment method with the least potential to be useful in a refugee camp is the RBC system: the camp isn't likely to contain high levels of pollutants nor is it feasible that the community will be able to sustain a high level of energy use. The two

most likely systems are the MBR system, because of potential space limitations and its flexibility, and the living machine system, because of its low-cost operation and its potential as a visible asset to the community. Each system requires either maintenance or technical training, which begins to open some employment and training opportunities within the community. Once the system cleans the water, the water can be re-introduced into the system. This “found” water greatly strengthens the overall resilience of the water management system.

Other water and waste management techniques include using dry toilets, reusing water for tasks that don't require potable water, irrigating with drip irrigation, strategically grading terrain for agriculture, and minimizing evaporation. A combination of some or all of these techniques should be explored on a case-by-

case basis. All opportunities to reduce water usage should be taken, as well as opportunities to reclaim water for other uses.

Water and wastewater management planning benefits from early analysis, wise design, and progressive planning: in situations where onsite water management may not be available immediately after a population has been relocated, communities designed from the beginning to accommodate onsite waste management will have an easier transition to more sustainable systems. For example, if it's determined that a living machine would most benefit the community, enough space needs to be allotted for the living machine's construction near populated areas without the need to relocate residents within the community; since one of the advantages of a living machine is its visual appeal, the allotted space needs to be in a location where many people will have access to it and be able to enjoy it.

### Levantine Design Customs

In order to preserve and promote community identity, it's important to consider local design traditions and expectations. This section explores construction materials, traditional landscape and community design, architectural styles, and strategies for sustainability.

## SHELTER

The first question involves shelter: what kind of shelter should be built and when? Current practice in emergency response is to promote a three-step building plan. Displaced persons are first directed to emergency shelters. After the initial danger has passed, displaced people are transferred to temporary shelters such as trailers or temporary apartments. People are expected to rebuild their permanent homes within three to five years while in temporary housing. Once construction is complete, the temporary housing is discarded and displaced persons resettle in their permanent homes.

This three-step process was seen as recently as 2005 in the U.S. Federal Emergency Management Agency's (FEMA) response to Hurricane Katrina along the Gulf Coast. Displaced persons initially either stayed in communal shelters in the affected areas or they relocated to places further inland. FEMA then issued its infamous trailers, in which people lived while permanent structures were rebuilt. However, as seen on the Gulf Coast and in other emergency response situations, many people live in "temporary" shelters significantly longer than originally intended ("Katrina Timeline"). They sometimes wait for decades before adequate housing is constructed.

Current disaster response professionals theorize that the first two steps too often take precedence over rebuilding permanent shelter because a lack of resources often dictates that the temporary shelters are used far longer than they were intended (Lizarralde, Johnson, and Davidson 7). Designers, Gonzalo Lizarralde, Cassidy Johnson, and Colin Davidson suggest that aid organizations begin the rebuilding process immediately, skipping the temporary shelter altogether (8). In practice, this would mean providing a "temporary" shelter intended for permanent use either in its structure or its materials.

The practice of building permanent shelters sooner would safeguard against repeating the mistakes made when constructing the original Palestinian refugee camps. Typically it takes several years for displaced people to fully recover from a disaster, so refugee camps are designed with that life cycle in mind. However, Palestinian refugee camps have been operational for more than sixty years (United Nations, *Jordan*). At the beginning of the conflict, no one imagined the conflict would last as long as it has. The Palestinian refugee camps serve as a warning and a reminder: disaster and conflict are unpredictable, so design with long-term plans in mind. Designed flexibility is essential.



Flexible designs will allow for multiple possible answers to the following questions: What will happen to the buildings, streets, and parks? Will the infrastructure be preserved and re-used for the next wave of refugees? Will it be redeveloped as a Jordanian community? Will it be dismantled? Will the residents have the choice to stay and be fully integrated into Jordanian society?

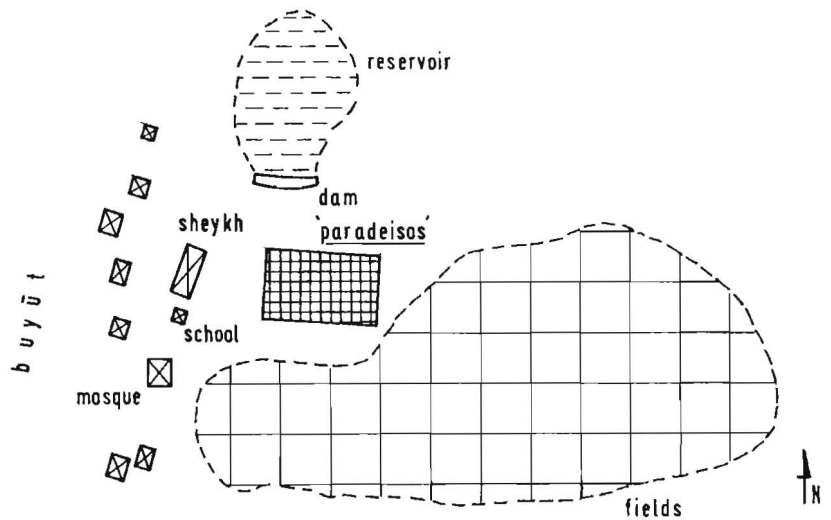


Figure 10: Traditional Community Design (Helms 43)

## LANDSCAPE

The earliest peoples of the Levant region were nomadic herders, a lifestyle that still influences the current era (Helms 43). As people began to build permanent settlements in the fourth millennium BCE, design

patterns began to emerge. The structures consisted of tents and earthen buildings, each facing downwind; separated women's, men's, and guests' facilities; public buildings such as schools and

mosques in central locations; and a source of water (43-44).

As seen in Figure 10 Traditional Community Design, reservoirs were constructed while agricultural enterprises

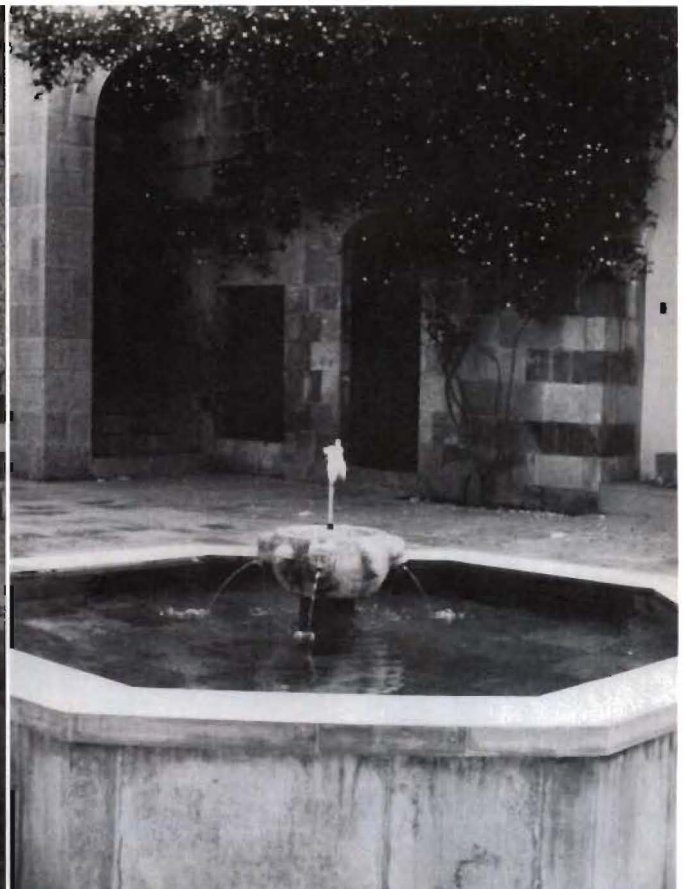


Figure 11: *Paradeisos* Fountains (Antonius and Tchraikian 34, 81)

clustered around the main living areas. Though the image does not show topography, it's important to realize the reservoir was located uphill from the settlement, which was itself located uphill from the fields. This allowed for natural water flow through the community and into the agricultural areas, reducing or even eliminating the need to pump water (Helms 42).

Likewise, it's notable that *paradeisos* gardens were constructed as a landscape element separate from the fields. The *paradeisos* were elaborate gardens filled with fruit, ornamental trees, birds, and some animals, and these

gardens served as places of both food production and respite. These gardens also often contained small fountains, shown in Figure 11: *Paradeisos Fountains*, that served as temperature control, focal points, and places to relieve thirst.

More recent settlements show similar patterns. Figure 12: *Community Design Around 1909* depicts a settlement constructed around the turn of the twentieth century. Again, combinations of tents and permanent structures are used to create separated spaces for men, women, and guests. The water source here is from a well rather than a reservoir, but

the same basic principles of design hold: dwellings face downwind, there are clear separations of spaces, and buildings are clustered around the main social attractions, in this case the mosque and the reception space for guests.

Building on these precedents, architect and planner Richard Kauffman designed the village of Nahalal, located in present-day Israel, in 1921 (Canaan 142). As Figure 13: *Agricultural Settlement of Nahalal* shows, Kauffman's design formalizes the clustering of agriculture and homes around the community's social center with concentric circles and radii. The advantages of this design include greater equality of spaces in terms of size and location to resources and a clearer definition of public and private space; however, the design fails to consider topography as an essential element to the flow of water from its source, through the community, and eventually through the fields. While an intriguing interpretation of the traditional community planning style, Kauffman's design ultimately falls short of fully integrating the community with the landscape.

## ARCHITECTURAL DETAILS

Levantine architecture is notable for its geometric patterns and careful attention to details. Buildings usually include a courtyard filled with fruits, herbs, and ornamental trees. Rooms are arranged around this courtyard. As

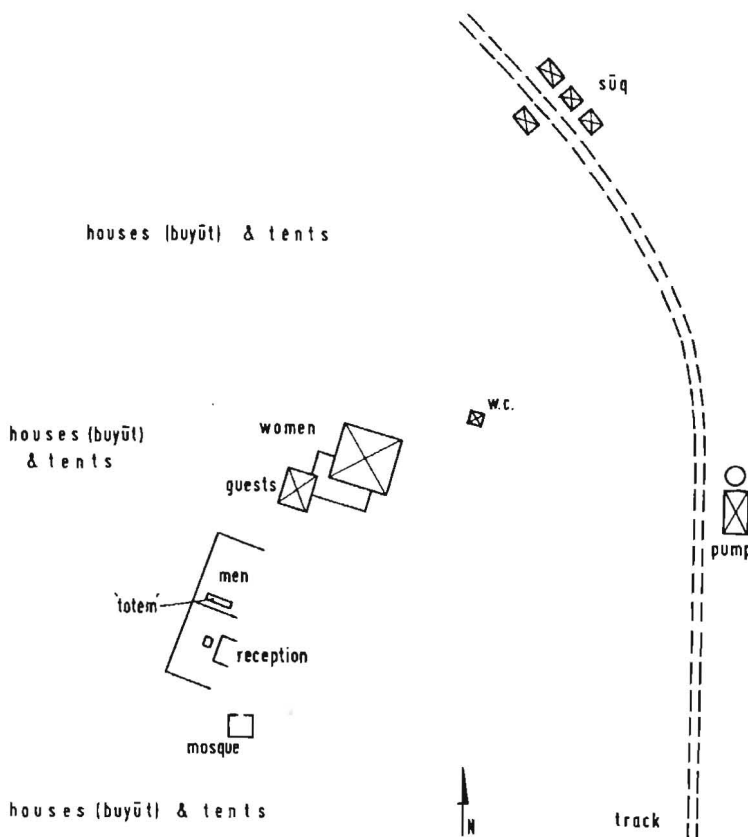


Figure 12: Community Design Around 1909 (Helms 42)



already mentioned, the buildings typically face downwind. Permanent structures were usually made from rammed-earth or clay brick reinforced with wooden beams (Helms 91), as seen in Figure 14: Wall Detail; however, local stone is also widely used (Antonius 8). More recently, since the early twentieth century, reinforced concrete has been a popular building material (Antonius and Tchrakian 8). Though most traditional homes were only one story, second and third stories have been added to the building vernacular since the nineteenth century to maximize space (Antonius and Tchrakian 9). The characteristically rectilinear

and one-story buildings often feature domes and arches (Figures 15 and 16). The “three arch” style is especially prominent in the northern regions of the Levant (Antonius and Tchrakian 14). The three arches are used in entry ways and windows, and they have been explored in surprising variety, as shown in Figure 17: Triple Arches.

In response to solar radiation, walls are typically thick and rooms small. Traditionally, grain, livestock, and family were housed under the same roof, which made natural ventilation and cooling vital—hence the orientation of the buildings downwind. Contemporary households

have abandoned the practice of keeping all possessions under one roof, but ventilation remains vital in crowded, urban conditions. Historically, ceilings were high to maximize ventilation, though this trend has changed in recent years with the introduction of air conditioning (Antonius and Tchrakian 6, 7, 9).

In addition, window screens called *mashrabiya* are frequently used. These screens, usually constructed of wood and featuring geometric or floral patterns, are used to mitigate the effects of the sun and to allow those inside buildings to view the street discreetly. As such, *mashrabiya* become



important adornments to the women's areas and to areas that receive much direct light. It is in respect to women that special care must be taken. Traditionally, families are accustomed to watching their streets and neighbors—a practice that greatly enhances a neighborhood's safety. At the same time, personal modesty and discretion is important for everybody, especially women. Therefore, while a certain lack of privacy is intentionally designed into Levantine homes (Antonius and Tchrakian 7), adequate private space should be provided for families to gather or change clothes so they can preserve their modesty (71).

### Sustainability

The region examined is in a warm, temperate climate with hot, dry summers (Csa on the Köppen-Geiger Climate Classification System). Sometimes called the "Mediterranean climate," the local weather conditions require special responses to the landscape and architecture to create sustainable communities. Utilizing natural ventilation in particular has important impacts on the viability of a community. With adequate ventilation, the need for artificial air conditioning is reduced and sometimes eliminated, which is ideal for refugee communities where air conditioning may not be an option for all families.

Figure 18: Passive Ventilation shows different house designs proposed for the

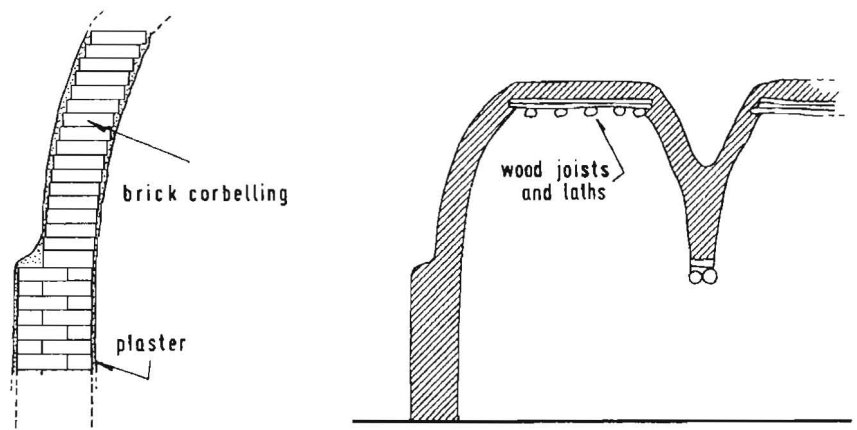


Figure 14: Wall Detail (Helms 91)

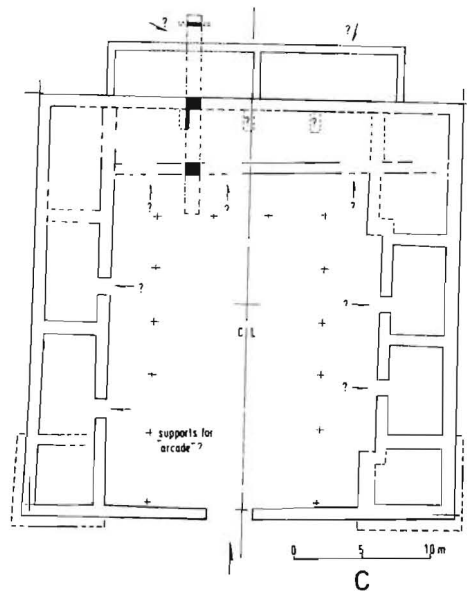


Figure 15: Building Plan (Helms 87)

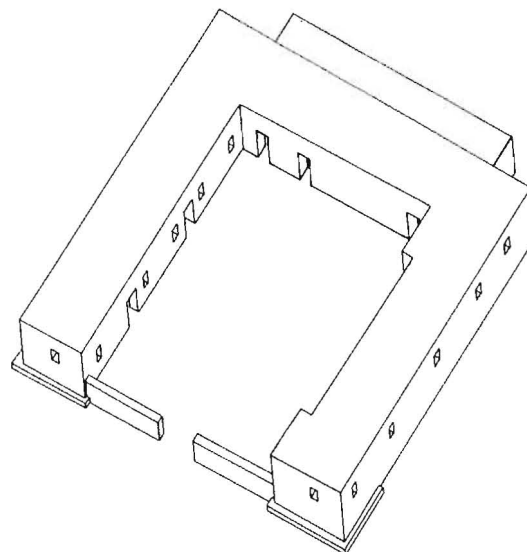
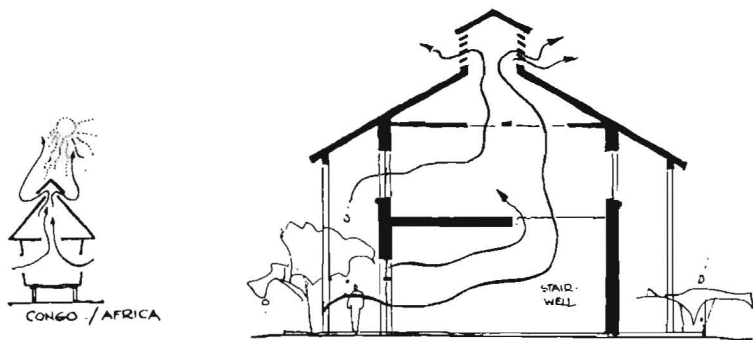


Figure 16: One Story Building (Helms 88)

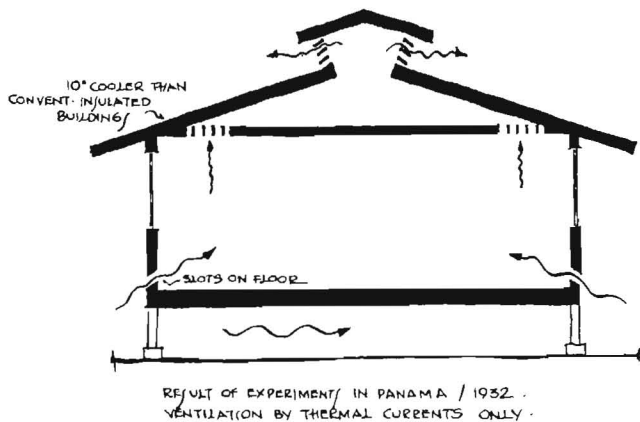




Figure 17: Triple Arches (Antonius and Tchrakian 58, 84)

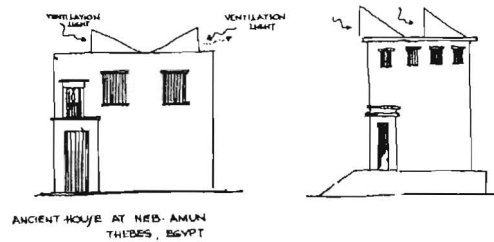


SMOKESTACK PRINCIPLE  
SOUTHERN PLANTATION HOUSE - U.S.A.



RESULT OF EXPERIMENT IN PANAMA / 1932.  
VENTILATION BY THERMAL CURRENTS ONLY.

Levant region that maximize natural ventilation. Other considerations for passive climate control include wind direction, solar gain, and construction materials.



While rain is scarce during the summer, this region can expect to receive 270-350 millimeters of rain annually, mostly during the winter months (Tarawneh and Kadioglu 125). As water is becoming globally scarce, it's important to harvest even this modest amount of rainfall. Butterfly roofs, such as those found in Figure 19: Water Catchment Techniques, and other catchment devices should be used to collect rain and dew to supply the community's water needs.

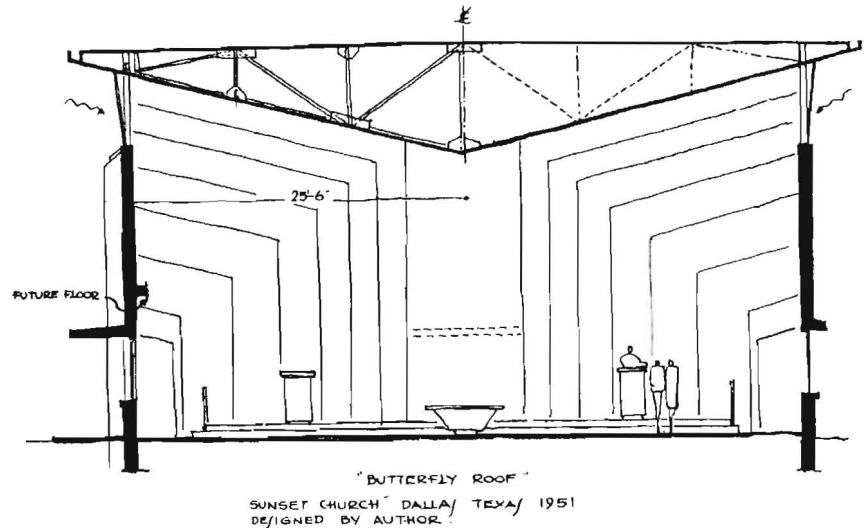
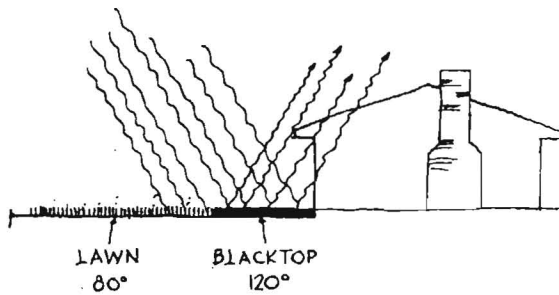
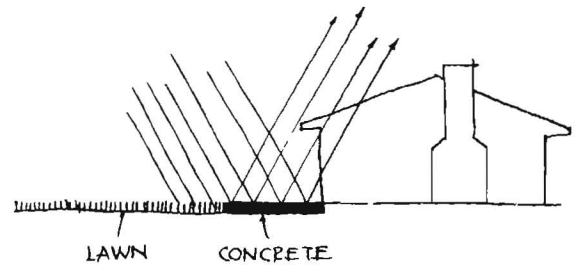


Figure 19: Water Catchment Technique (Canaan 171)

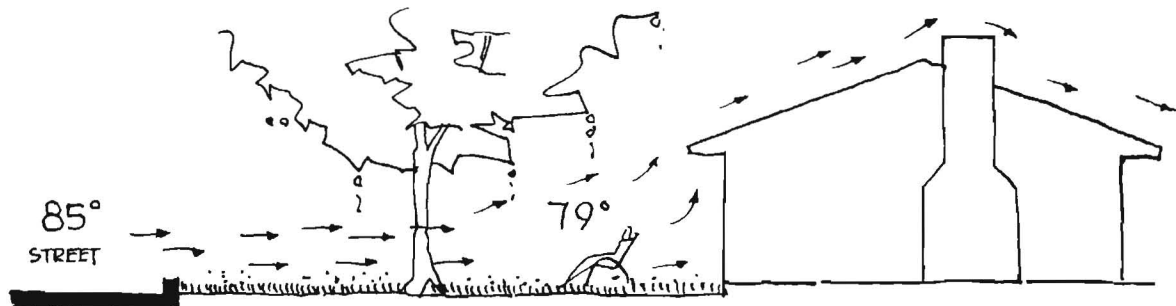
Figure 20: Creating Microclimates shows various responses to these concerns, all of which have been used in the Levant. Notable design decisions include the use of high-albedo materials that reflect solar energy, such as vegetation, canvas, and light-colored stone; circulation of water in outdoor fountains to cool areas; and the use of physical barriers and screens to protect buildings and people from the sun.



RADIANT TEMPERATURE.



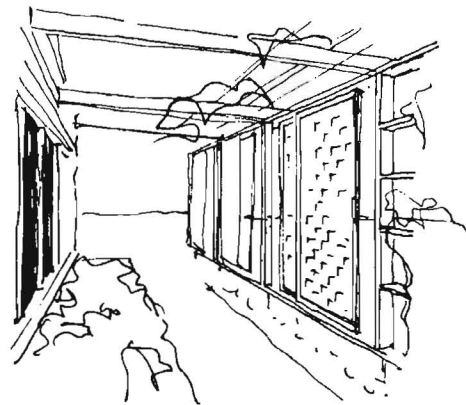
VARIATION IN LIGHT REFLECTION.



EFFECTIVE EMPLOYMENT OF SOD AS AN ELEMENT FOR COOLING.



OVERHEAD-DOOR TYPE OF SOLAR-SHADING DEVICE.

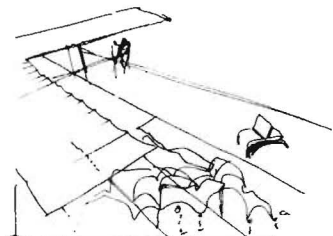


SLIDING SHUTTERS FOR SHADING WEST WALL.

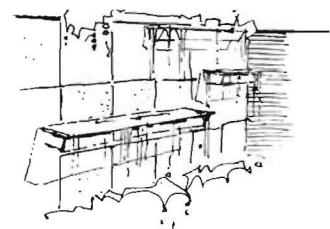
FROM: BUILDING RESEARCH ADVISORY BOARD "WEATHER AND THE BUILDING INDUSTRY." FITCH J.M. P.95



RADIANT COOLING DEVICE. FOR ARID CLIMATE.



CANVAS CEILING SHADES FOR OPEN PATIO.



METAL BOXES MOUNTED ON ROUGH CONCRETE WALL, FILLED WITH CIRCULATED FLOW OF WATER. HELP TO COOL THE HOT SUMMER.



# Community-Building Techniques

Figure 21: Palestinian Loss of Land 1946-2000 shows that nearly all of Palestine's former territory is now a part of Israel, making returning to lost homes or land impossible for most refugees. Therefore, it's important to include spaces in the refugee camps for cultural preservation and development, places for community-centered activities, and other infrastructure that promotes strong identity and confidence.

The Palestinian culture is a family-oriented, patriarchal society. While men organize and lead most activities out

of the home, women have an important, respected role as caretakers of the household. Community design should respect the cultural mores of the community while looking for opportunities to cater to women's specific needs. It should especially consider opportunities for women's and girls' education, medical attention, and community involvement.

## Environmental Design

Given the complaints from camp refugees that are documented, it is clear that the majority of refugees' concerns fall into two categories: health concerns and environmental concerns. Refugees' environmental concerns are many, and all

can be addressed through better design. For example, camp refugees typically live in crowded conditions, which are defined by having three or more people per room (see Figure 22: Crowding). To alleviate the crowded conditions, architects can design homes that are more easily expanded or altered to allow for family growth. Likewise, it's important to design camps to be adaptable to families' needs. For example, a ten-person household needs about twice as much space and resources as a five-person household. If the land for the refugee camp is divided into equally-sized lots, then some families will have more than they need while others will

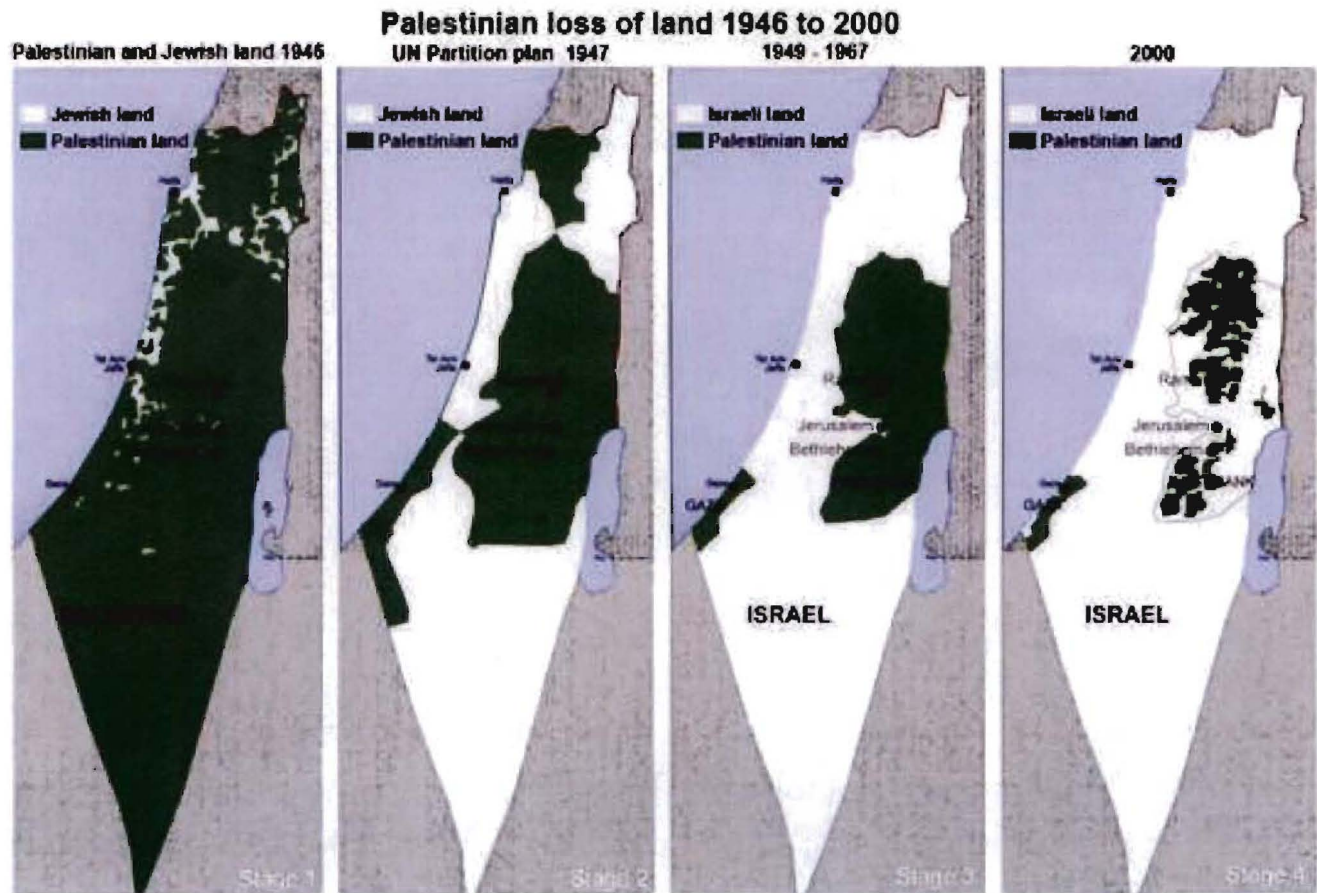


Figure 21: Palestinian Loss of Land 1946-2000 ("Palestinian Loss")



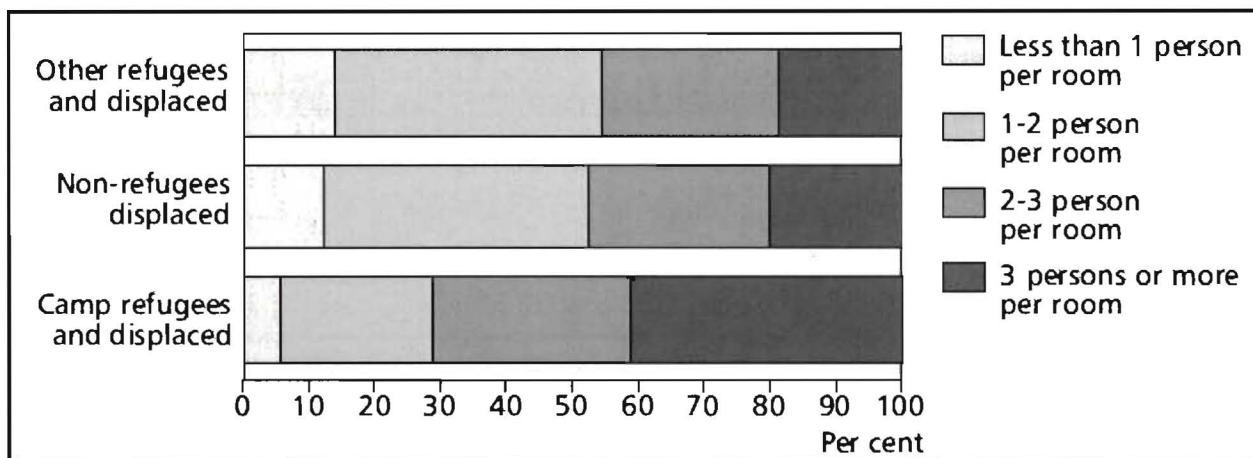


Figure 22: Crowding, Number of Persons per Room (Arneberg 26)

have less. It's better to start with lots sized for the "typical" family, which can then be altered to each family's needs. One way to ensure flexibility in housing without overcrowding is to divide homes in the community into neighborhoods surrounded by green space. The green space allows for some flexibility in house and lot size as long as the overall balance of the community's land resources is maintained.

Other environmental concerns largely relate to water infrastructure. As [Figure 23 Housing and Infrastructure Standards](#) shows, a shocking 60% of camp refugees don't have a private bath or shower while 30% don't have a toilet in their home. This is especially troubling since women in particular are faced with hazardous conditions when leaving the home to take advantage of community bath houses (Hyndman 95). To ensure safety and privacy for women, it's essential

to provide the necessary infrastructure for bathing and personal relief within their homes.

Interestingly, all demographic groups surveyed in Arneberg's research experience weekly water cutoffs. Jordan suffers from water resource shortages, so providing alternative water sources for the refugee community would make a significant difference in providing for the community's water needs. As explored in the next section, with proper land balancing and resource management, refugee communities near Amman can harvest enough water to meet all their needs. This would be a huge step towards infrastructure improvements as well as health improvements: when there's enough water for proper hygiene and hydration, fewer people will be sick or in need of medical care.

Figure 24: Environment Inside and Outside Dwelling shows

additional environmental concerns. Again, these concerns can be addressed by thoughtful, responsible design and stewardship. Climate control in dwellings is a top priority, especially since it cannot be assumed the majority of refugees are able to afford air conditioning units or the electricity to run them. Drawing on the traditional design techniques outlined above, homes in refugee camps can be built that maintain comfortable temperatures and plenty of ventilation. One reason homes in existing camps are so uncomfortable is that most are built of thin concrete and brick walls that offer little insulation from the elements. Add poor insulation to poor design that doesn't allow for air flow, and you have hot, humid homes in the summer and damp, cold homes in the winter.

Designing homes with thick walls made from earthen materials gives

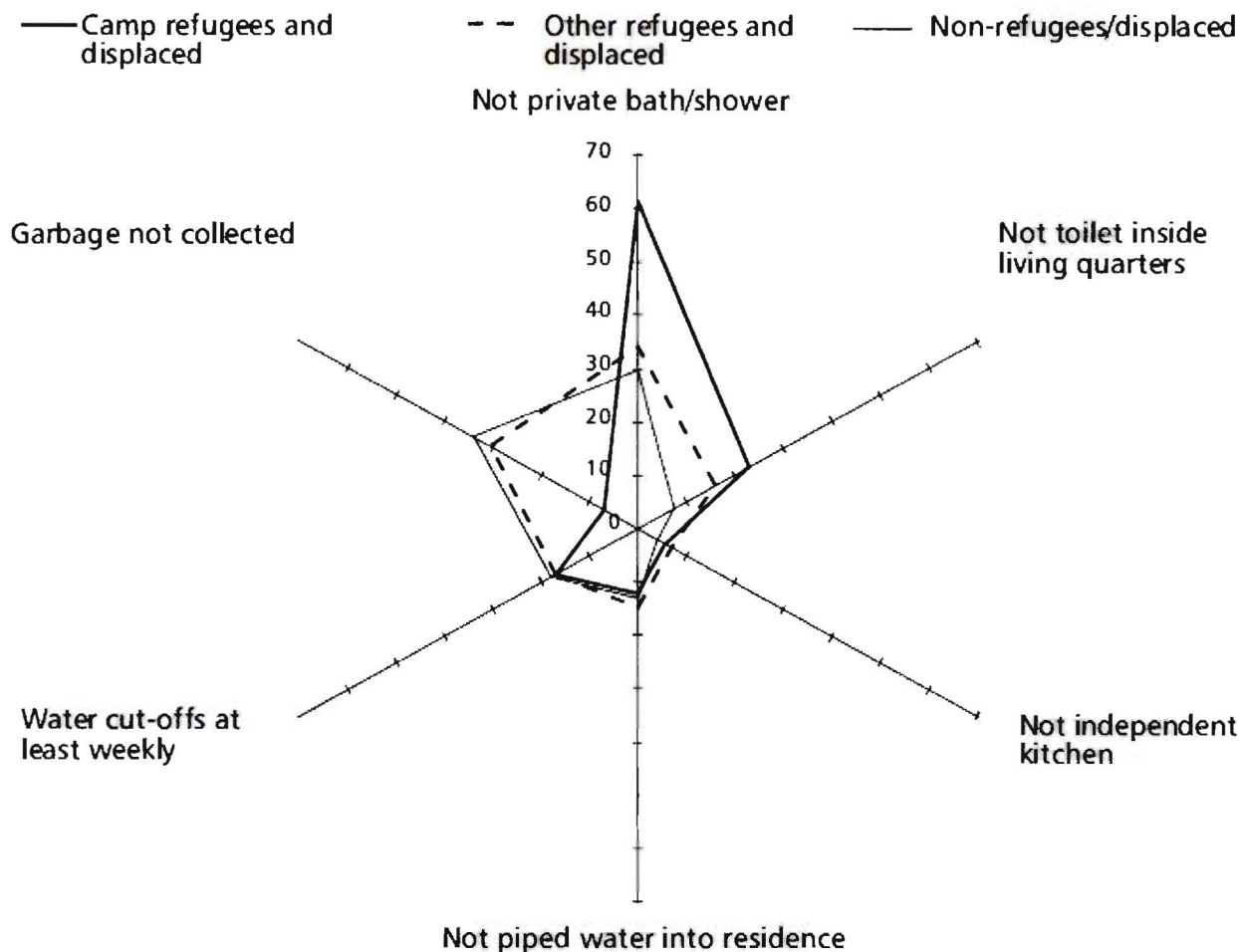


Figure 23: Housing and Infrastructure Standard (Arneberg 26)

the appropriate level of insulation to protect residents from the harshest outdoor conditions. Adding windows and aligning homes to catch the natural breezes from the east also encourage ample air flow through the home, creating a comfortable indoor space with fresh air. Adding outdoor spaces with different microclimates gives residents options when seeking refuge or respite from the weather. Trees and awnings for shade can make

an otherwise uninhabitable courtyard perfectly pleasant on a summer day. In public places, grey water can be used in modest fountains to create a cooling effect around the pool before it is redirected towards the agricultural fields. Whatever techniques are used, creating comfortable homes and neighborhoods promotes pride in one's space and reduces stress. Additionally, keeping the human body at a comfortable temperature promotes human

health. Designing homes to be comfortable, ventilated, and insulated is yet another technique for promoting health within the camps.

### Healthcare-Oriented Design

The types of environmental concerns the camp refugees have expressed often directly relate to health concerns. It is clear that health and environment are intricately connected. Arneberg documents that camp refugees experience

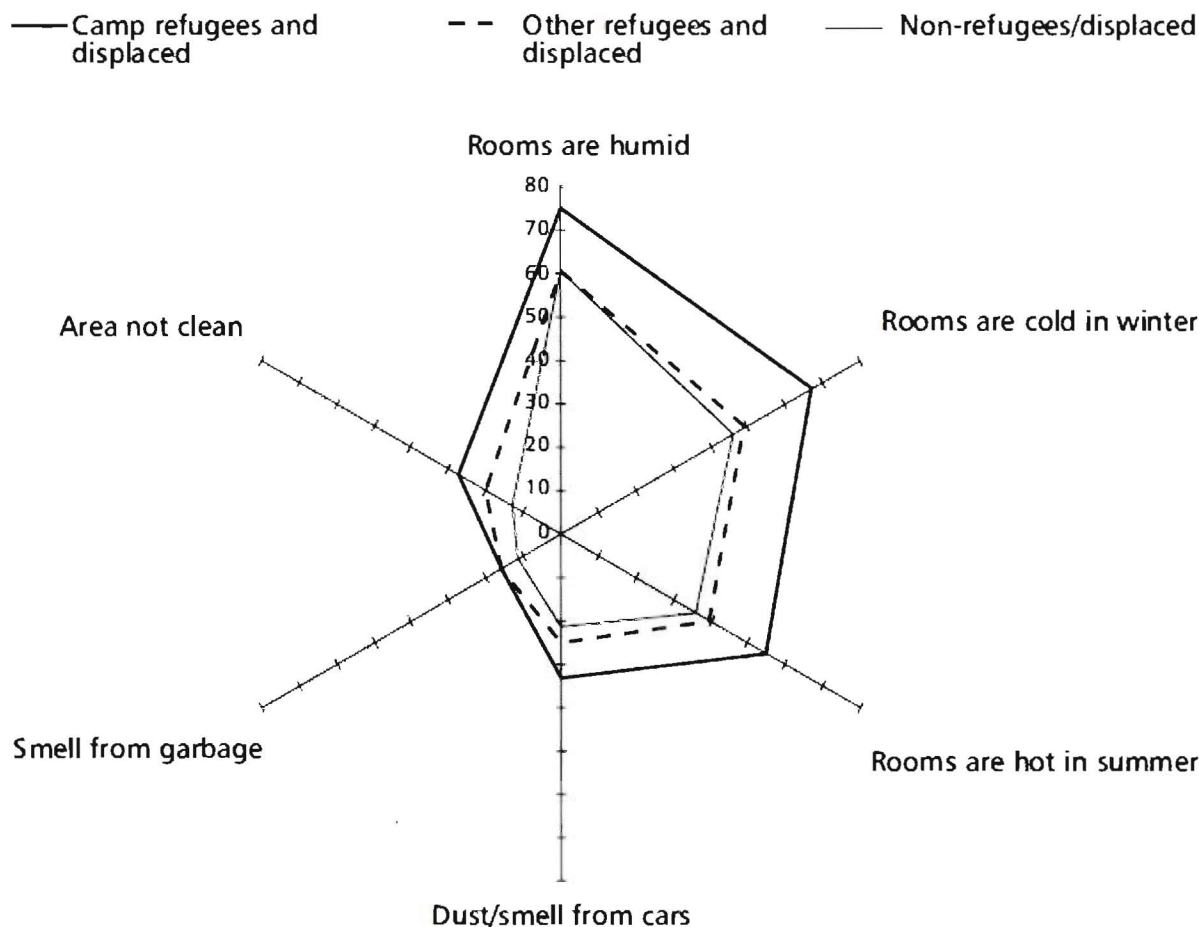


Figure 24: Environment Inside and Outside Dwelling (Arneberg 27)

lower levels of health than their non-camp counterparts do, along with poorer living conditions. It's not surprising that people living poorly are feeling poorly, too. Figure 25: Severe, Prolonged Illness or Injury shows that camp refugees experience twice as many instances of severe, prolonged illness or injury compared to their non-refugee neighbors (Arneberg 29). They also rate their health worse than their neighbors do, as

shown in Figure 26 Health Self Assessment.

Surprisingly, male camp refugees rate their health lower than females in the same situation do. This could relate to these populations' mental distress index, which was calculated after each group was asked to assess "how severely he or she was affected by the following symptoms during the week before the interview: nervousness, headaches,

depressions, worry, feeling worthless, continuously feeling fearful, and feeling hopeless about the future" (Arneberg 31). Arneberg concludes, "female camp refugees and displaced report that they experience continuous fear more often than other women do," and "[a]mong young male camp refugees and displaced, more than 30% say that they feel hopeless about the future" (32). Clearly more can be done to give refugees a



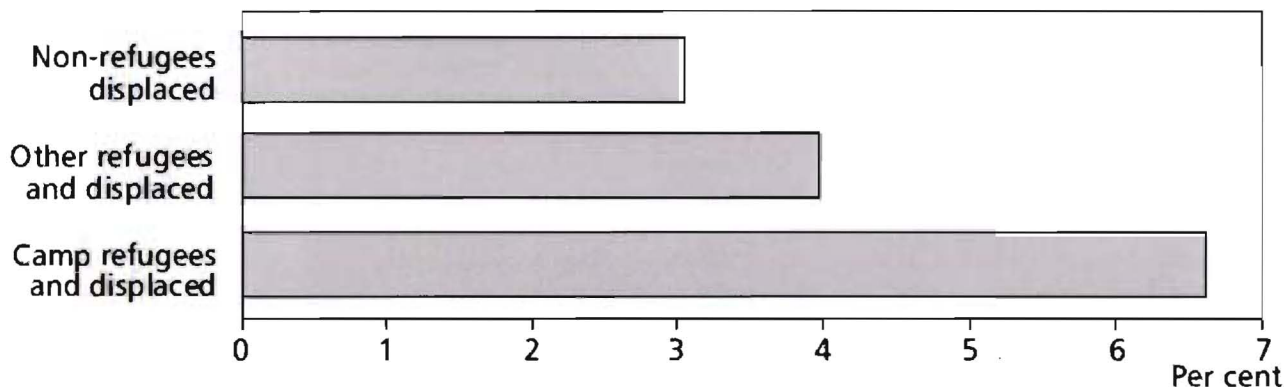


Figure 25: Severe, Prolonged Illness or Injury (Ameberg 30)

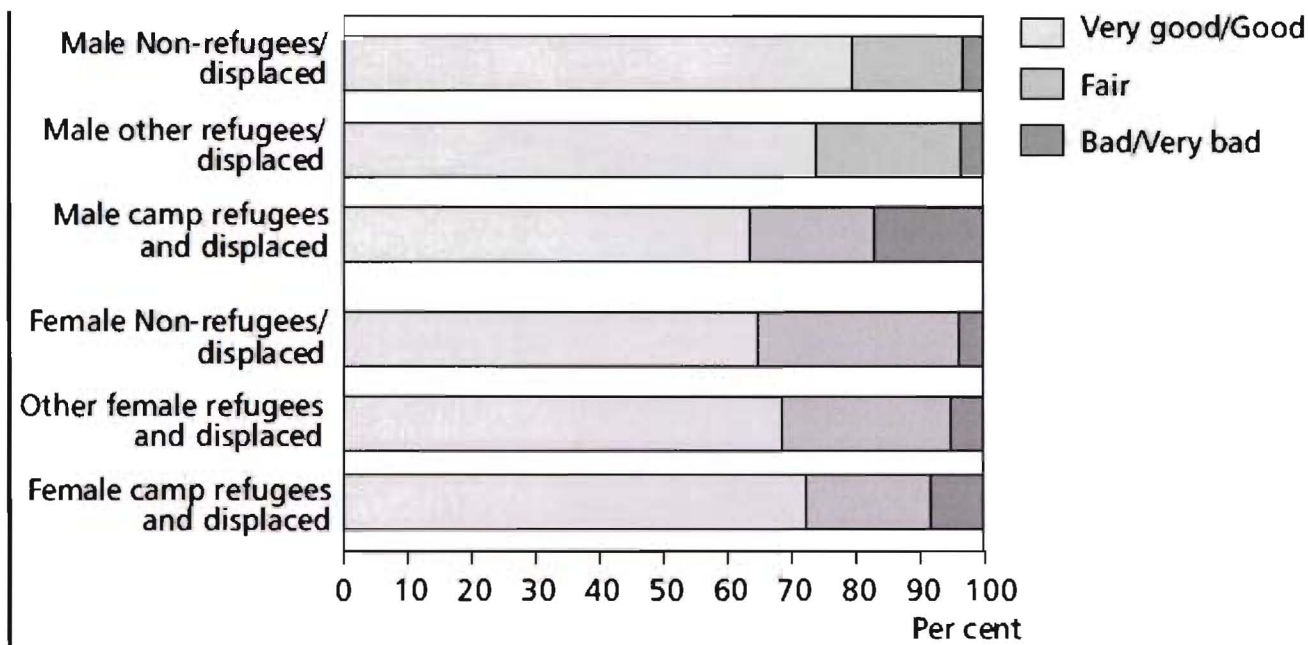


Figure 26: Health Self-Assessment (Ameberg 29)

## Landscape Typologies

Many of camp refugees' illnesses relate to poor living conditions. Managing resources and land improves environmental conditions in the camps.

All communities rely on three types of landscapes:

productive, natural, and developed (Figure 27: Landscape Typologies). Productive landscapes are those that humans use to produce goods such as food, timber, and cotton. Natural landscapes remain preserved (or restored) to provide habitat for plants and animals, natural air and water filtration, and

places for carbon to be absorbed back into the earth. Developed landscape refers to areas in which humans have performed construction: for example, buildings and roads.

Frequently, these landscape typologies overlap. For communities with limited

## Developed/Productive

Example: residential fruit or vegetable gardens

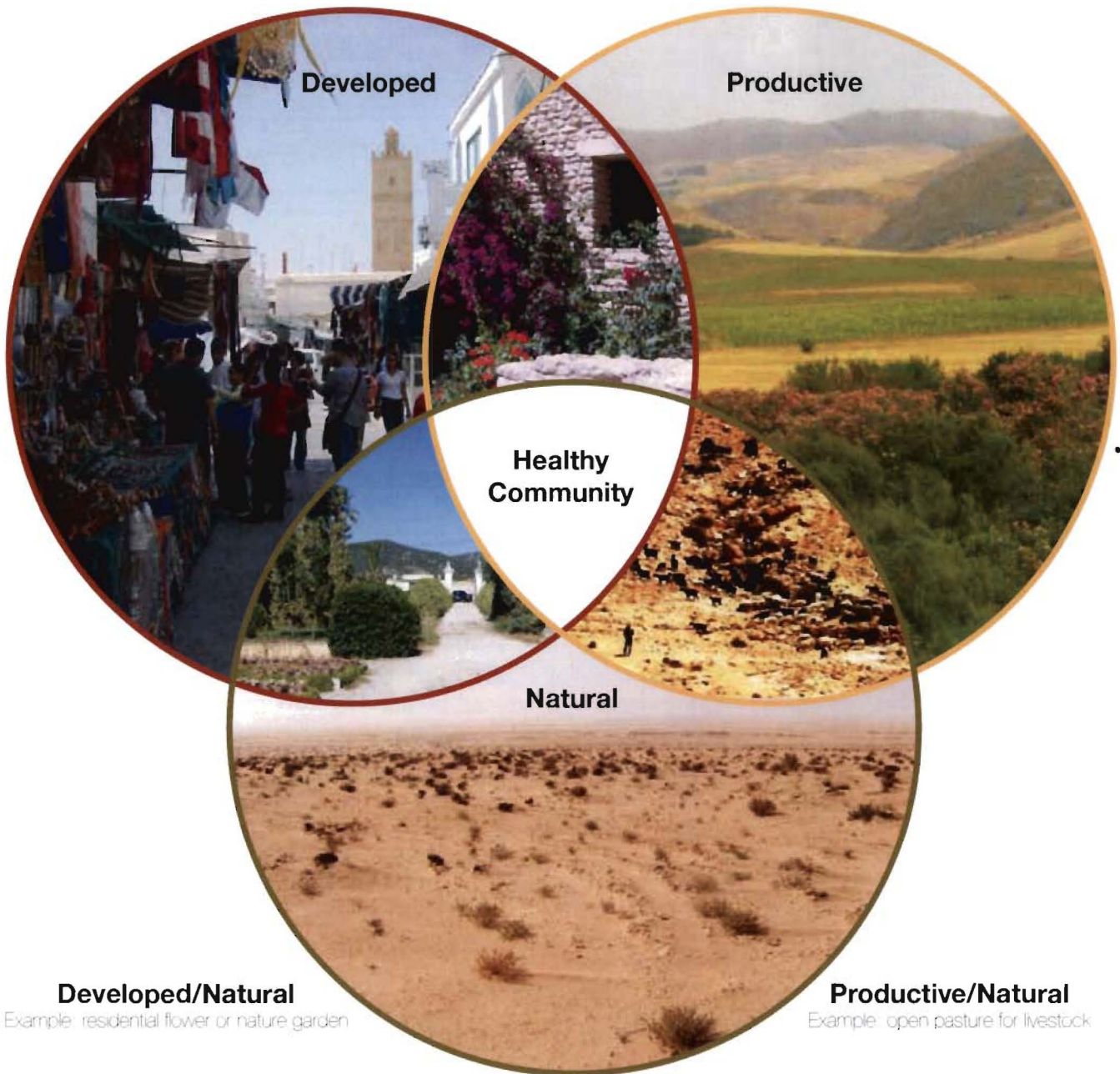


Figure 27: Landscape Typologies (Barnes)

space, overlapping landscapes are essential to human health and vitality.

Because of overlapping, each landscape can be difficult to define. Common development overlaps natural and developed landscapes in the forms of parks and wilderness trails. Likewise,

many landscapes are allowed to maintain a period of “natural” growth so that people can then come to use the resources. Instances of this include forestry and herding animals. And of course, small scale productive landscapes, which we typically call gardens, tend to be nestled into the developed

landscape, further blurring the lines between each type of landscape. Importantly, within the extents of a given community exists a balance of each type of landscape.

The healthiest, most durable communities will have managed land so that all three landscapes are fully included



in the available space. How can designers measure how much land a community needs to provide enough of each landscape typology? Eco-balancing offers an answer.

### “Eco-Balancing”

Designer Pliny Fisk, Director of the Center for Maximum Potential Building Systems in Austin, Texas, has developed the system of “eco-balancing” to try to account for all of a community’s needs. Typical eco-balancing calculates all the land needed to grow food, collect water, provide building materials for shelter, produce energy, and offer enough vegetation to purify air and offset carbon outputs. These calculations provide excellent, concrete starting points for determining land use within a community.

Due to the emergency nature of refugee communities, this study will examine land use for only the most basic needs of the community: water, food, shelter, and energy production. The following calculations and recommendations apply to the proposed new refugee camp in Amman.

### WATER

Human water needs fall into three categories: drinking water, household water, and agricultural water. According to UN-Water, each person needs between 20-50 liters of water every day for drinking, cooking, and washing (United

Nations, *Drinking Water and Sanitation*). Using the higher estimate to accommodate for an arid climate, that makes 18,250 liters—or about 18 m<sup>3</sup>—of water per person per year.

Likewise, 7,070 m<sup>3</sup> of water are needed to irrigate each hectare of agricultural land per year (United States, *Irrigation Water Use*). Since each person needs 0.24 hectares of agricultural land to produce a year’s supply of food (see “Food” below), an additional 1,700 m<sup>3</sup> of water per person per year must be allocated for agricultural irrigation.

Additionally, one sheep needs an average of 0.0037 m<sup>3</sup> of water per day (1.35 m<sup>3</sup> of water per year) (Neary). Averaging 2 sheep per person per year (see “Food” below), 2.7 m<sup>3</sup> of water must be added per person to account for each person’s share of livestock. (Note: Grazing land for livestock will not be irrigated.)

Thus, each year one person needs about 18 m<sup>3</sup> of water for household and personal use, 1,700 m<sup>3</sup> of water to irrigate agricultural land, and 2.7 m<sup>3</sup> of water for livestock, in this case sheep. This brings the total need for water per person to about 1,720 m<sup>3</sup> of water each year.

The average precipitation in Jordan is 0.31 meters of water per year (Tarawneh and Kadioglu 125). Since rainwater harvesting is the

most reliable source of water, this project assumes all water comes from harvested rainwater. **Therefore, each person needs about 5550 m<sup>2</sup> of surface area for water collection.** Reclaimed water sources will be used to strengthen the system.

### FOOD

#### Livestock

The most sustainable diet is meat-free; however, most Palestinians prefer to eat meat. Sheep in particular are an important food source, especially during the holy month of Ramadan. Sheep provide dairy, wool, and manure in addition to meat, making them an ideal choice of livestock. Each sheep needs (“Are You Thinking”):

- 1.35 m<sup>3</sup> of water per year (Neary)
- 0.70 metric tons of food per year (“Are You Thinking”)
- 1.39 m<sup>2</sup> shelter space per ewe

Land needs to be allocated for each sheep’s water collection, food production, and shelter. The “Water” calculations already include land for water collection for livestock.

“Poor” pasture produces about 2.3 metric tons of hay per hectare while “good” pasture produces about 11 metric tons of hay per hectare (“Are You Thinking”). Assuming “average” pasture quality, the community can expect about 5 metric

tons of hay per hectare. Approximately 1400 m<sup>2</sup> of pasture will produce the required 0.7 metric tons of food per year for each sheep. Additionally, each sheep needs 1.4 m<sup>2</sup> of shelter space in a barn (“Are You Thinking”). The area needed for the livestock shelter and the associated building materials is calculated in “Building Materials” below.

According to Jihad M. Quasem in *The Pakistan Journal of Nutrition*, the average person in Jordan consumes about 30 kg of meat per year, a rate that increased by 10% between 2006 and 2008 (332). Live sheep can weigh anywhere between 14 and 50 kg (Neary); a 45 kg live sheep will produce about 15 kg of butchered meat (“Locker Lamb”). Assuming a person eats 30 kg of meat per year (based on Quasem’s 2008 average), an average of two sheep per person would supply the community with sufficient meat. **This means each person requires 2,800 m<sup>3</sup> of pasture for livestock.**

### Agricultural Cropland

The Center for Maximum Potential Building Systems (CMPBS) recommends a 50 m<sup>2</sup> home garden for each person. By current agricultural ratios, each person also has 2,530 m<sup>2</sup> of cropland per person (Fisk, “Food”). **Therefore, each person needs 2,580 m<sup>2</sup> of cropland to produce food.**

### SHELTER

Several possible materials were considered for building shelters, including wood, stone, straw, earth, and concrete. The most feasible building materials for the area are earth and stone, since these are the most abundant and can be harvested on site. Straw could be used once the community’s agriculture is established, but for initial emergency construction, earth and stone work best.

The average house size is 70 m<sup>2</sup> in Jordan, with an average of 10.38 m<sup>2</sup> of living space per person (Al-Khatib, Arafat, and Musmar 187). UNWRA uses number of rooms per person—rather than number of square meters per person—to determine whether an area is overcrowded. However, Pliny Fisk’s research points to 45 m<sup>2</sup> of sheltered space per person as a benchmark for sustainable dwellings (Fisk, “Materials”). Residential design is largely a personal decision for families, based on household size, activities, and preferences. For ease of calculation, 45 m<sup>2</sup> per person will be used to calculate how much space is needed for building materials and living areas. In practice, there will be much variation throughout the community.

Earthen walls are typically 0.60 meters thick (Fisk, “Materials”). Drawing on architectural precedent, the ceilings of dwellings should be approximately 3 meters

high to allow for natural ventilation. Floors of the shelters will need to be 0.15 meters thick, and earthen brick arches will create the structure for the ceiling and roof. Dimensions of spaces will be—on average—5 meters by 9 meters. Average shelter spaces will have:

- 2 walls of 27 m<sup>2</sup> and 0.60 meters thick (34.4 m<sup>3</sup> of rammed earth)
- 2 walls of 15 m<sup>2</sup> and 0.60 meters thick (18 m<sup>3</sup> of rammed earth)
- A floor of 45 m<sup>2</sup> and 0.15 meters thick (6.75 m<sup>3</sup> of rammed earth)
- A ceiling/roof that covers 45 m<sup>2</sup> (amount of rammed earth will vary)

The walls and floor require about 60 m<sup>3</sup> of rammed earth. If soil is excavated to a depth of 1.5 meters and 80% of that is suitable for building material each house will need about 50 m<sup>2</sup> of land for construction materials, plus an additional 20 m<sup>2</sup> of material for ceiling/roof construction, bringing **the total land for residential construction material to 70 m<sup>2</sup> per person** (Fisk, “Materials”).

Likewise, the building materials needed for a livestock barn are as follows: each sheep requires 1.4 m<sup>2</sup> of living space in the barn (“Are You Thinking”). With a ceiling height of 2.5 meters, the area measures 2.5 meters by 0.7 meters by 2 meters. The space will therefore have:

- 2 walls of 1.75 m<sup>2</sup> at



- 0.60 meters thick (2.1 m<sup>3</sup> of rammed earth)
- 2 walls of 5 m<sup>2</sup> at 0.60 meters thick (6.0 m<sup>3</sup> of rammed earth)
- A floor of 1.4 m<sup>2</sup> and 0.15 meters thick (0.21 m<sup>3</sup> of rammed earth)
- A ceiling/roof that covers 1.4 m<sup>2</sup> (amount of rammed earth will vary)

The walls and floor require about 8.3 m<sup>3</sup> of rammed earth. If the soil is excavated to a depth of 1.5 meters and 80% of that is suitable for building material, each sheep will need about 7 m<sup>2</sup> of land for construction materials, plus an additional 2.8 m<sup>2</sup> of material for ceiling/roof construction, bringing the total land for livestock barn construction material to 9.8 m<sup>2</sup> per sheep (Fisk “Materials”).

Since each person is allocated two sheep, the total land for construction materials per person is about 90 m<sup>2</sup>. The total land needed per person for shelter (including the livestock's shelter) is about 48 m<sup>2</sup>. **Together, each person requires about 140 m<sup>2</sup> of land for shelter and building materials.**

## ENERGY

Of the types of energy production studied for this region, only solar energy offers a viable energy source for the refugee community. There isn't enough wind energy to support wind turbines, and Jordan lacks

fossil fuel deposits. Passive solar energy can be used extensively throughout the camp to heat water, cook food, and warm homes. As the camp develops, it will need solar panels to provide electricity for the schools, hospital, clinics, and homes.

Assuming each person uses 6 kwh of electricity per day (based on Fisk's energy benchmarks) and the solar panels will receive 4-5 hours of direct sunlight per day, each person will need approximately 90 m<sup>2</sup> of photovoltaic solar panels (Fisk, “Solar”).

## TOTAL LAND PER PERSON

In the area around Amman, each person needs the following:

- 5,550 m<sup>2</sup> of water collecting surfaces
- 2,800 m<sup>2</sup> of pasture
- 2,580 m<sup>2</sup> of cropland
- 140 m<sup>2</sup> for shelter
- 90 m<sup>2</sup> for energy
- **Total: 11,160 m<sup>2</sup> of land**

Figure 28: Land Needed per Person shows the breakdown of how much land is needed to support one person in a refugee camp in Jordan. The land estimate of 11,160 m<sup>2</sup> per person does not include landscape overlap, so it is the most generous land allowance per person. In practice, landscapes overlap, giving areas multiple uses. For example, solar panels can also serve as water-collecting surface area, and both can be mounted on a house's roof.

Understanding these numbers is important because they give an accurate idea of how many people a community can sustainably support. They also guide the community's design process by providing benchmarks for how much of each landscape typology—natural, productive, and developed—is needed within the community.



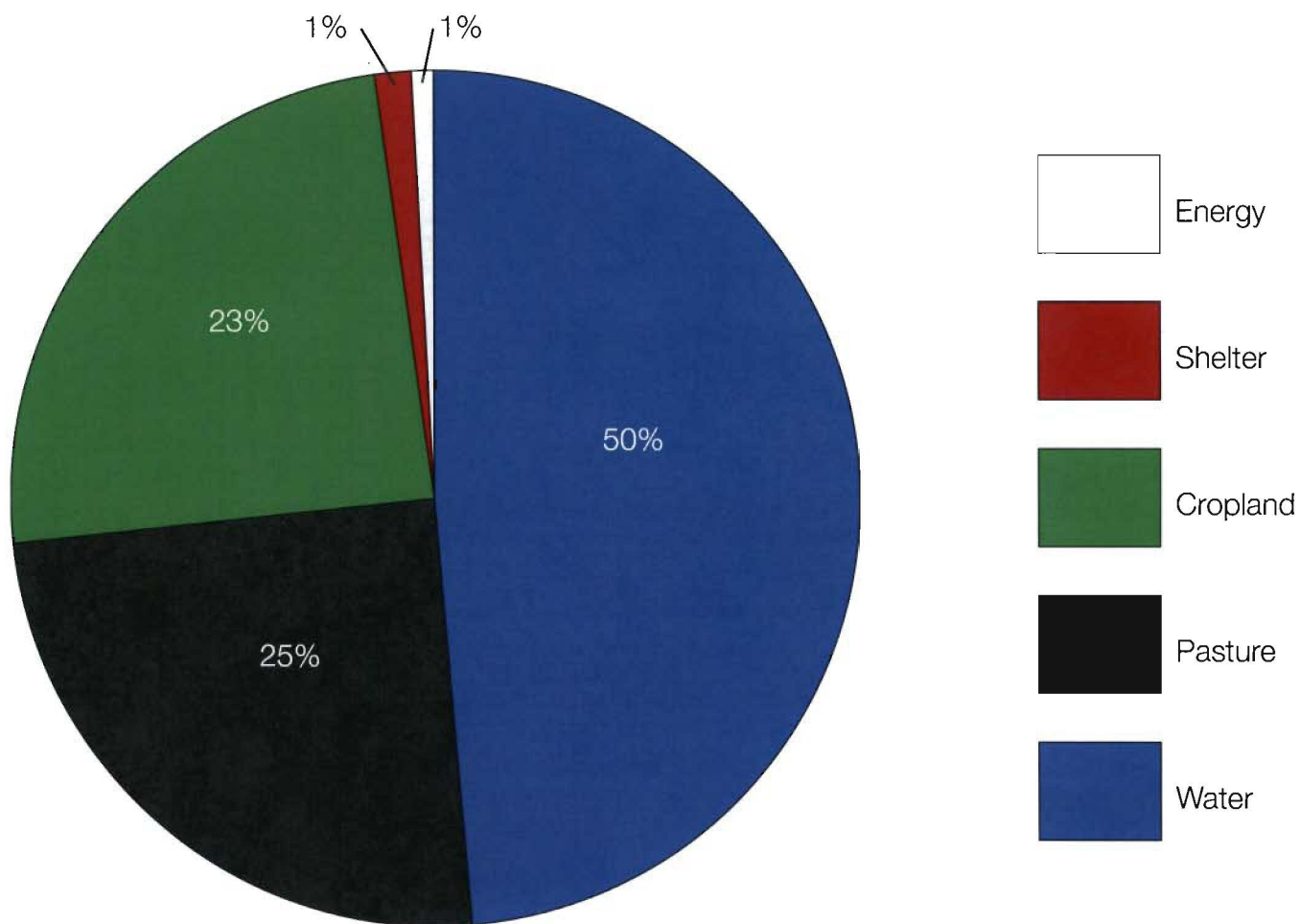


Figure 28: Land Use Needed per Person

**Total Land Needed to support one refugee: 11,160 m<sup>2</sup> (1.116 hectares)**

Case Studies

The following case studies examine communities in arid environments. Three of the case studies are from refugee communities. These examples demonstrate the challenges and possibilities in refugee community design.

San Felipe, Nuevo León, México

Located in Mexico's northeastern deserts, the *ejido* (or community) of San Felipe was struggling to survive. The community had long used well water, but it was discovered that the water was naturally contaminated with arsenic. The next-nearest source of water was three miles away, and the residents often made the trek on foot. Desperate for a better solution, the community reached out to the nearby university of Tecnológico de Monterrey.

After some community meetings, environmental studies, and plenty of trial and error, San Felipe's population of about 100 people now survives entirely on rainwater.

The community constructed several cisterns of various sizes and designs to capture and store the little rainfall the desert offered. The largest cistern, seen in Figure 34, collects and stores all the water needed for the community's personal uses such as drinking, washing, and bathing.



Figure 29: Above ground cistern for agriculture (Barnes)

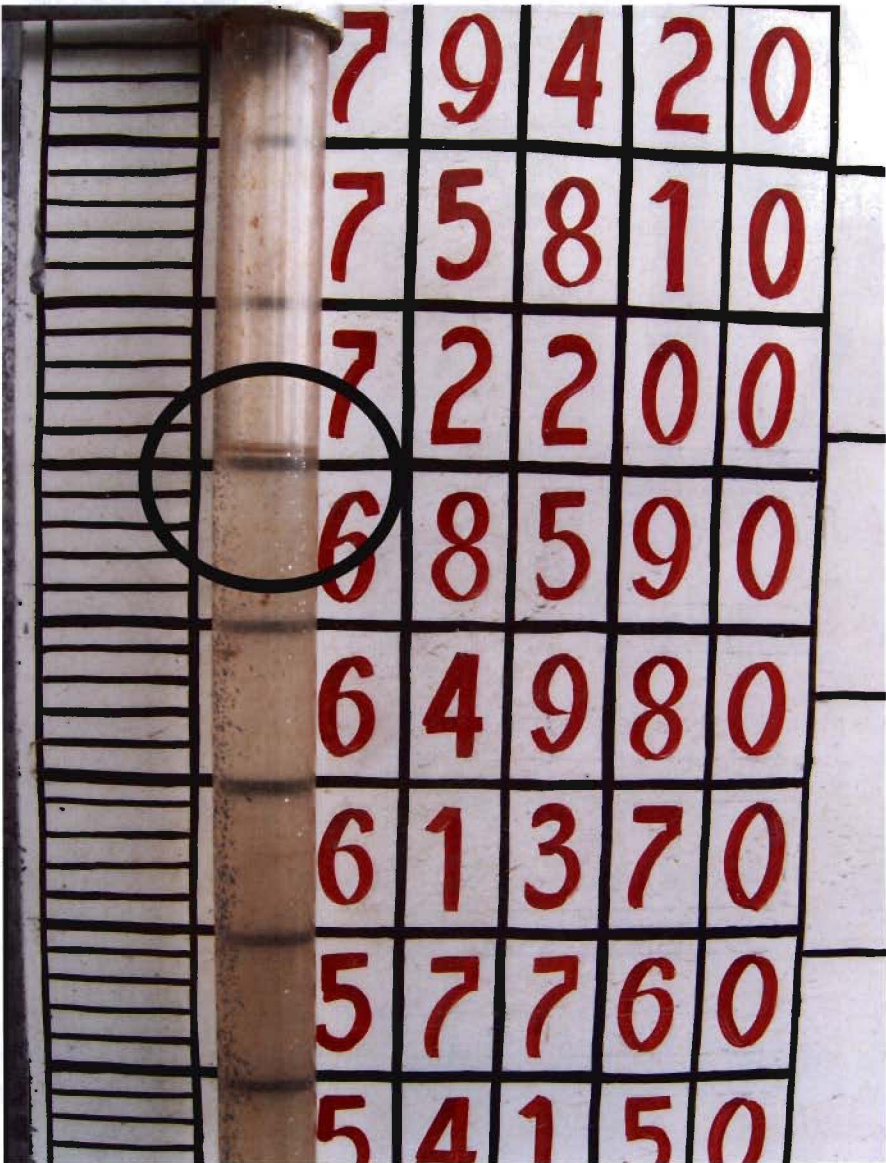


Figure 30: Water level in cistern, liters (Barnes)



The other cisterns are used to collect, store, and distribute water to the community's agricultural fields. The cisterns harvest enough water to maintain agriculture and pasture for domesticated deer, which together meet all of the community's needs. The cisterns are so successful that the community has started selling surplus water to nearby communities for an additional source of income.

The community has also embraced traditional adobe



Figure 31: House built from earth-based materials (Barnes)



Figure 32: Underground cistern for agriculture (Barnes)



Figure 33: Water collection from roof (Barnes)



Figure 34: Cistern for hygienic uses (Barnes)

buildings, pictured in Figures 31 and 33. These buildings, made of local materials, offer better insulation and air circulation than concrete block buildings, which had become the norm. Additionally, the adobe bricks can be created for just pennies, making their use economical as well. Of all the case studies, San Felipe does the best job at addressing and responding to the local environmental conditions.



## Dagahaley Refugee Camp, Kenya

Despite the United Nations High Commissioner for Refugees' recommendations for how to provide safety for refugees, the Dagahaley Refugee Camp in Kenya illustrates the tendency for camps to be designed with services clustered along a main road, accessible best by car and not well on foot. The reason for this is safety for aid workers and for security of resources, which are both important aspects of refugee camp design; however, the camp's design doesn't respond to cultural or social needs expressed by the refugees (Hyndman 96). The "green belt" streets begin to address the need for outdoor space, but these areas are little more than narrow pathways. Interestingly, these pathways run parallel to the main road, making access to the market, hospital, and other amenities less direct.

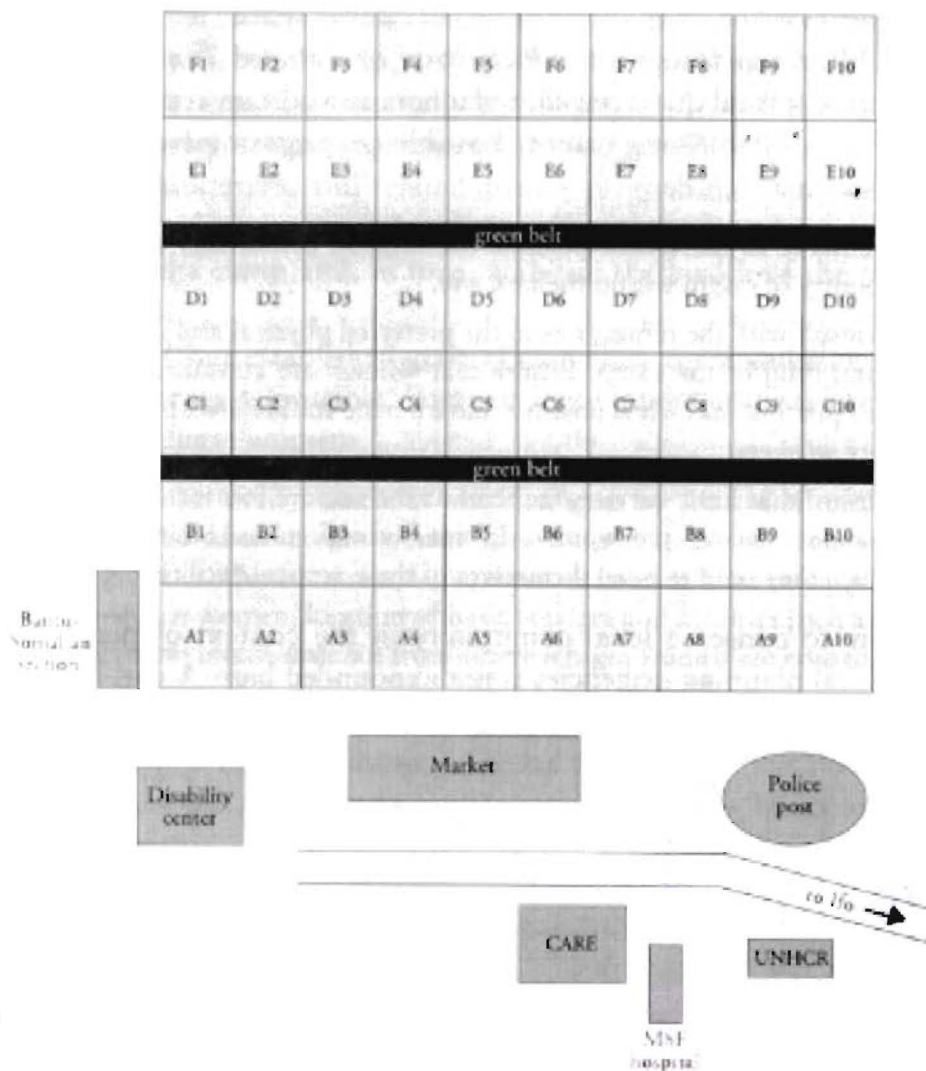


Figure 35: Map of Dagahaley Refugee Camp (Schuurman 96)

## Hagadera Refugee Camp, Kenya

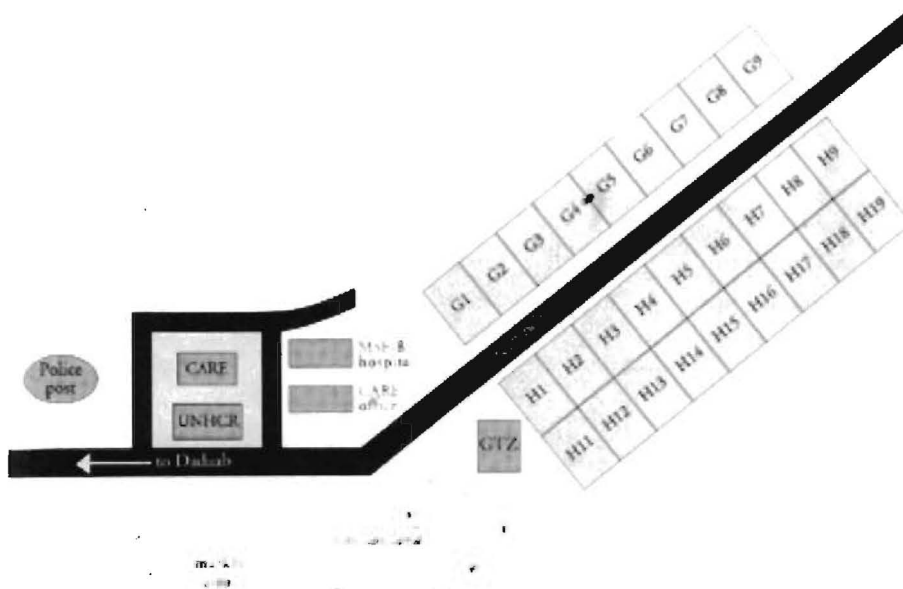
Like Dagahaley, Hagadera refugee camp clusters services along the main road, close to the police post, for added security to resources and staff. This camp shows an area of "wet lowlands," presumably an area unsuitable for construction and therefore left natural. This camp's arrangement, which aligns one cluster of housing with the road and aligns the other cluster's road perpendicular to the road, allows for greatly improved

access for all community members to the camp's services as compared to Dagahaley. The camp could have taken the additional step in developing a program for the "wet lowlands" area, such as a community garden or gathering area.

## Ifo Refugee Camp, Kenya

Ifo refugee camp represents the only example of a camp developed for two different—and opposing—cultural groups. Services are divided

to allow for an Ethiopian school, reception center, and neighborhood and a Sudanese school, reception center, and neighborhood. Security becomes increasingly important for refugees from political conflicts; often the need for security outweighs other needs, such as living in a healthy environment. Though this camp includes amenities such as a transit center and community center, the area still lacks natural areas or convenient paths



F1	E1	D1	C1	B1	A1	J1
F2	E2	D2	C2	B2	A2	J2
F3	E3	D3	C3	B3	A3	J3
F4	E4	D4	C4	B4	A4	J4
F5	E5	D5	C5	B5	A5	
F6	E6	D6	C6	B6	A6	
F7	E7	D7	C7	B7	A7	
F8	E8	D8	C8	B8	A8	
F9	E9	D9	C9	B9	A9	
F10	E10	D10	C10	B10	A10	

Figure 36: Map of Hagadera Refugee Camp (Schuurman 97)

between residences and the camp's services. At the same time, this camp has an area designated for "future expansion." This is the first case study in which the possibility of ongoing conflict and additional refugees has been accounted for. Perhaps the "future expansion" area will have the additional environmental community amenities that could promote greater human health and stability.

**Case Study Summary**  
UNHCR camps tend to have several marks of efficiency: they're arranged on a grid, have clustered community services, and provide for only the most basic human needs. They neglect to provide a healthy environment for refugees though. Hagadera comes the closest to providing safety, decent access to resources for all residents, potential outdoor space, and economic opportunity in the

marketplace. However, it does not address the possible need for expansion, as the Ifo camp does. None of the camps address long-term living conditions or self-sufficiency in the form of food or energy production, and all the camps demonstrate a heavy reliance on outside resources for camp construction and sustainment. In contrast, San Felipe demonstrates that communities in arid environments have the

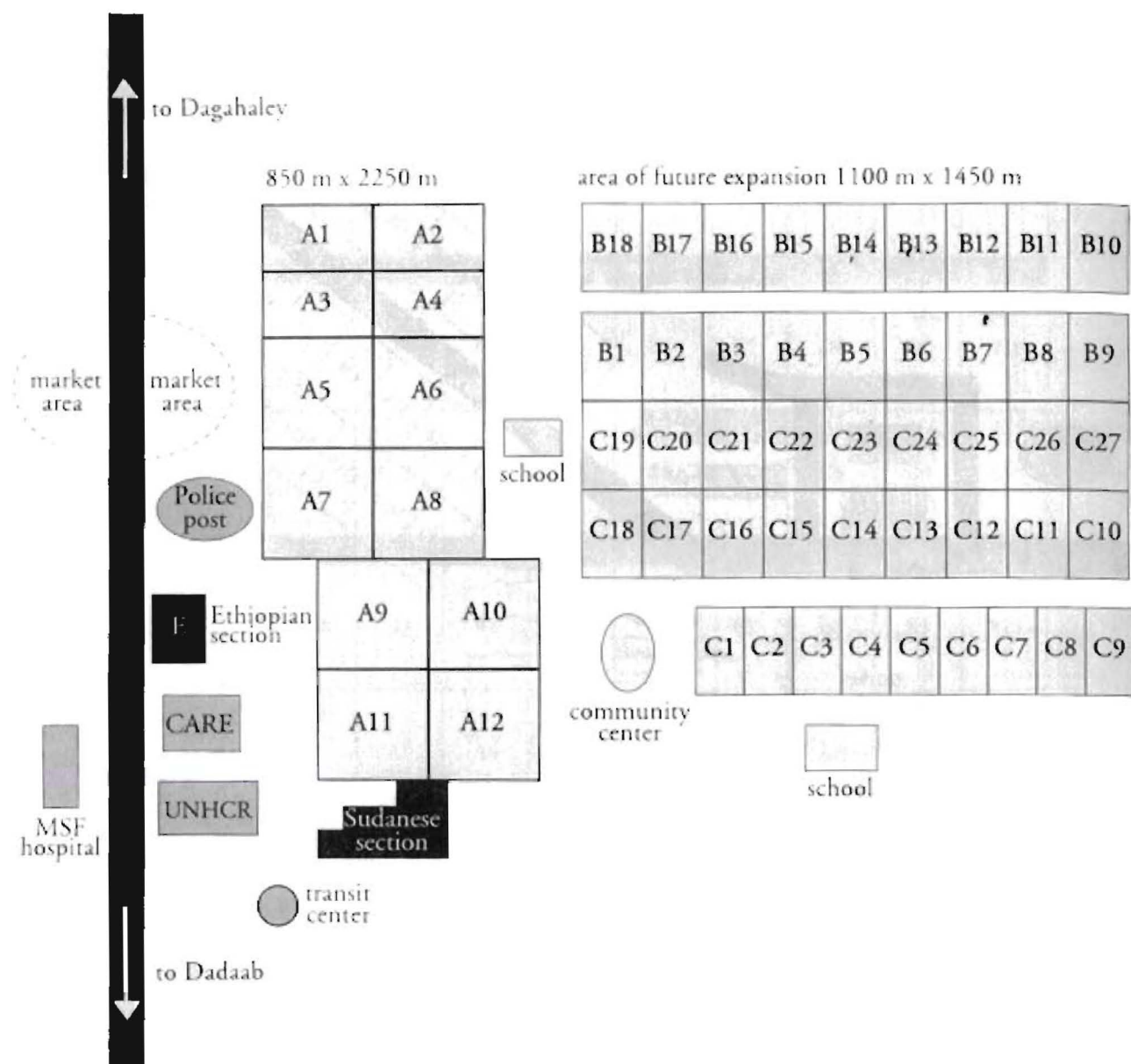


Figure 37: Map of Ifo Refugee Camp (Schuurman 98)

potential to be self-reliant and thrive. Arid climates can provide for a community's needs when the community respects the environment and the design works with the natural conditions of the site.

An ideal refugee camp would provide the services, security, and efficiency of the UNHCR camps while harnessing the sustainable technology demonstrated in San Felipe.





## The Framework

### General Framework for Developing a Refugee Community

Step 1: Examine demographics and describe the "Typical Family" and its needs.

Step 2: Define the "ideal" eco-balancing for the location and population.

Step 3: Identify a site and apply eco-balancing as described in Steps 1 and 2.

Step 4: Program the space.

Step 5: Design and adjust.

### A Framework for a Palestinian Refugee Community

At this point, the "typical" Palestinian family and its needs have been thoroughly investigated. Goals for the community come from that investigation and serve to direct the design. The goals were chosen in response to the community's needs as outlined in the Review of Literature.

#### Goals

1. Design for optimal physical and mental health
2. Create a self-sustaining community, including water independence
3. Use natural systems to enhance community's character
4. Integrate community with landscape
5. Respond to the

- community's specific cultural needs
6. Create strong sense of place and belonging

The two top priorities are to address the residents' physical and psychological health as well as to address the even and adequate distribution of resources. The other goals address issues of healing-- of the land, of the community, and of the culture. The community will be organized first according to

clinics, as shown in Figure 38: Conceptual Design 1, in order to provide better access to medical care for all residents, and second according to water flow, as shown in Figure 39: Conceptual Design 2, in order to best integrate the community with the environment.

One additional point about community organization needs to be made: every community--refugee and otherwise-- fits into a

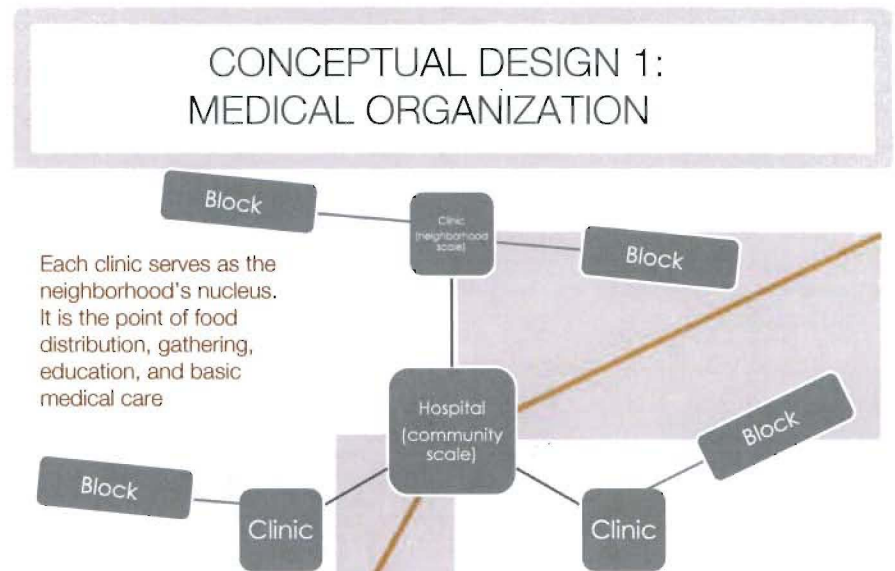


Figure 38: Conceptual Design 1



- Allow water to flow through community
- Water picks up nutrients
- Waters, fertilizes agricultural enterprises
- Allows for natural area to stabilize soils
- Protects homes from flooding
- Historical precedent

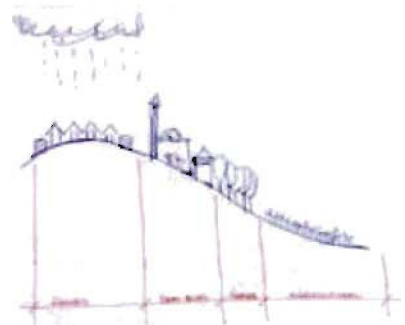


Figure 39: Conceptual Design 2

hierarchy within the city. The basic unit is the home. Groups of homes create neighborhoods, which in turn create communities, which themselves make up the city (Figure 40: Community Hierarchy). The proposed community must fit into this network in order to be truly successful.

### Program

The program for the community in Amman was

created from analyzing existing refugee camp programs, refugee's specific needs, and in response to what the available land can sustainably support.

The community will have:

- 1 Hospital
- 3 Schools with Clinics
- 1 Women's Program Center
- 1 Rehabilitation Center
- 1 Food Distribution Center
- 1 Environmental Health
- Office

- 1 Camp Development
- Office
- 1,554,000 m<sup>2</sup> of water collecting surfaces
- 1,506,400 m<sup>2</sup> of land for food production
- 39,200 m<sup>2</sup> of land for material harvesting
- 25,200 m<sup>2</sup> of solar panel surfaces

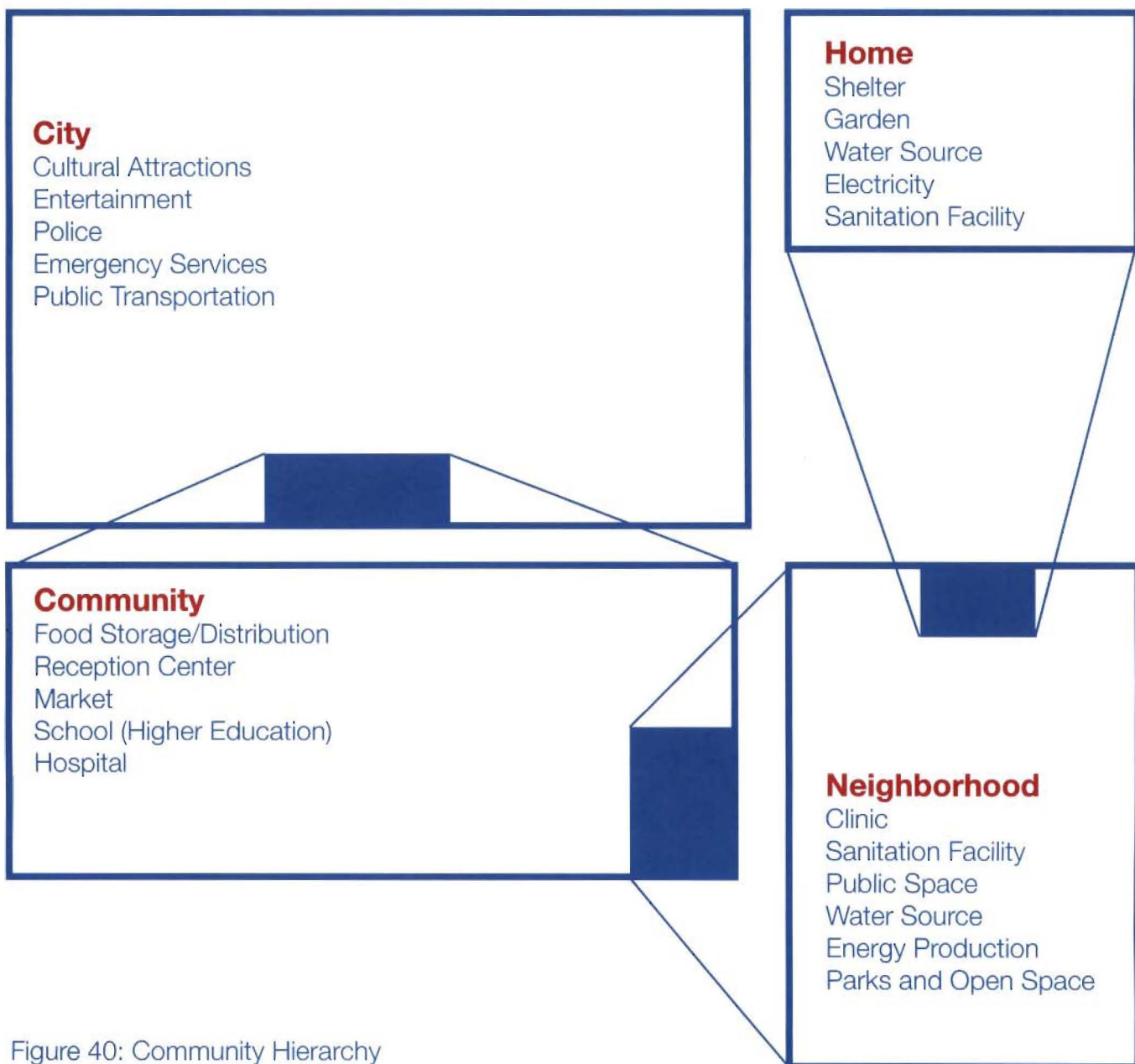


Figure 40: Community Hierarchy



## The Design

With the framework that has been established, how might it be utilized to create a healthier refugee community in Amman?

### Site, Setting, and Context

Seen in Figure 41, a site was chosen for its proximity to Amman, its existing agricultural fields, and its access to major transportation routes.

Images reveal the varying topography and the agricultural richness of the site. There is an existing resort facility (Figure 42: Everest Resort), which will be rehabilitated into the community's hospital, while other existing buildings will either be similarly re-purposed or harvested for their materials. Winter photographs reveal snow, which, once melted, can be stored in

cisterns for the summer's agricultural needs. It should be noted the seasonal river appears to have pools of water in the summer, which could be additional sources for water. Also, the site offers splendid views of Amman and the surrounding landscape as seen in Figures 43 through 46.



Figure 41: Vicinity Map





Figure 42: Everest Resort  
(Google Earth)



Figure 43: Everest Resort (Google Earth)



Figure 44: Amman from Site (Google Earth)



Figure 45: Site's Agriculture (Google Earth)



Figure 46: View from Everest Resort in Winter (Google Earth)



## Inventory and Analysis

The site's major feature is its rolling topography. From the highest point to the lowest, there is a difference of over 150 meters. A major highway runs along the west side of the site while residential neighborhoods border the east and south. A seasonal river defines most of the site's perimeter, carving two valleys that support a cross-shaped plateau. The southeast corner of the site is nearly flat, and some of the nearby neighborhood development is creeping into the area.

Water naturally flows from the center of the site outward, then around the perimeter, gradually making its way north along the seasonal riverbed. See [Figure 47: Site Inventory](#).

The site consists of approximately 307.5 hectares. The Everest Resort crowns the highest hill on the site, and a few neighborhoods have sprung up in the surrounding foothills. Otherwise, most of the land is agricultural. Wind comes off the distant Mediterranean Sea from the west, and the sun comes from the south. Several roads run through the site, but many appear to be simple dirt roads worn into the land by convenience rather than by plan.

Following the tradition of community planning based on water flow, water should be collected and stored along the ridge lines with the neighborhoods next in line

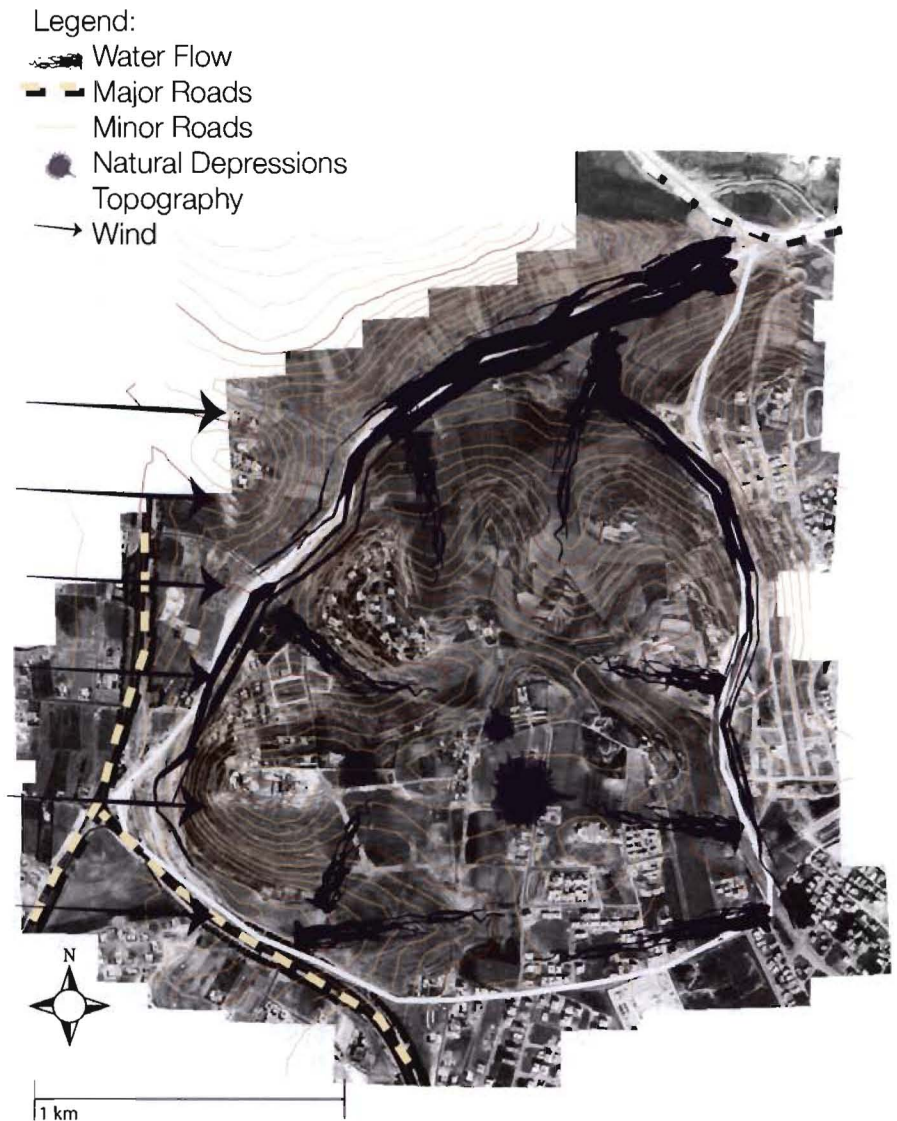


Figure 47: Site Inventory

downhill, as shown in [Figure 48: Site Analysis](#).

There are two good points of entry, one from the main road, and the other leading to the adjacent neighborhood. The community's neighborhoods are best located on the four corners of the cross-shaped ridge lines, here marked by


red circles. The area where the ridge lines cross should be used to gather and store water, and it would also be easily accessed by all four communities as a park space.

The seasonal river needs to have a protective vegetated buffer of at least 15 meters, but it can extend into the



Legend:

 Good Neighborhood Sites

 Good Cistern Locations

Topography

 Entrances

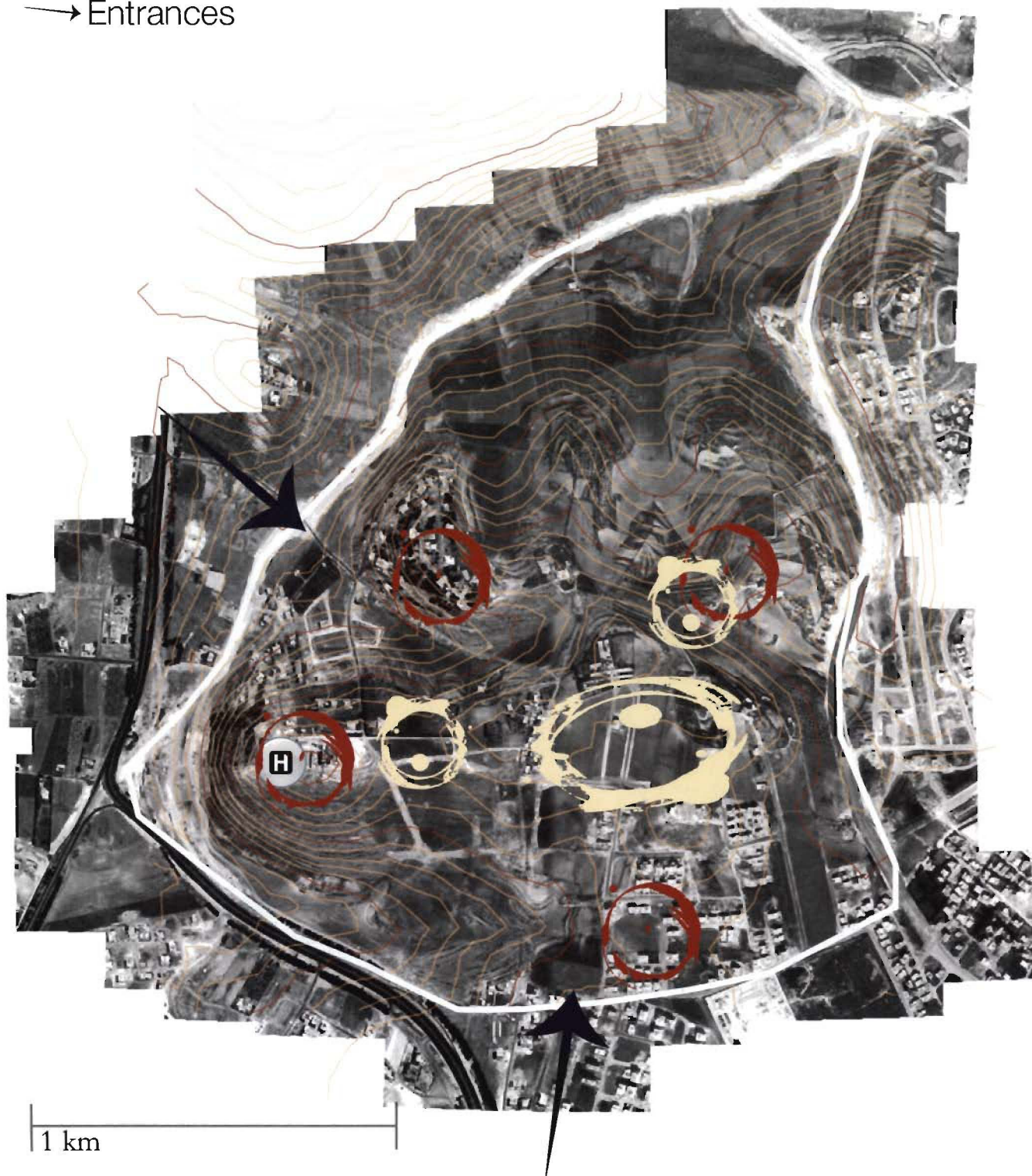


Figure 48: Site Analysis



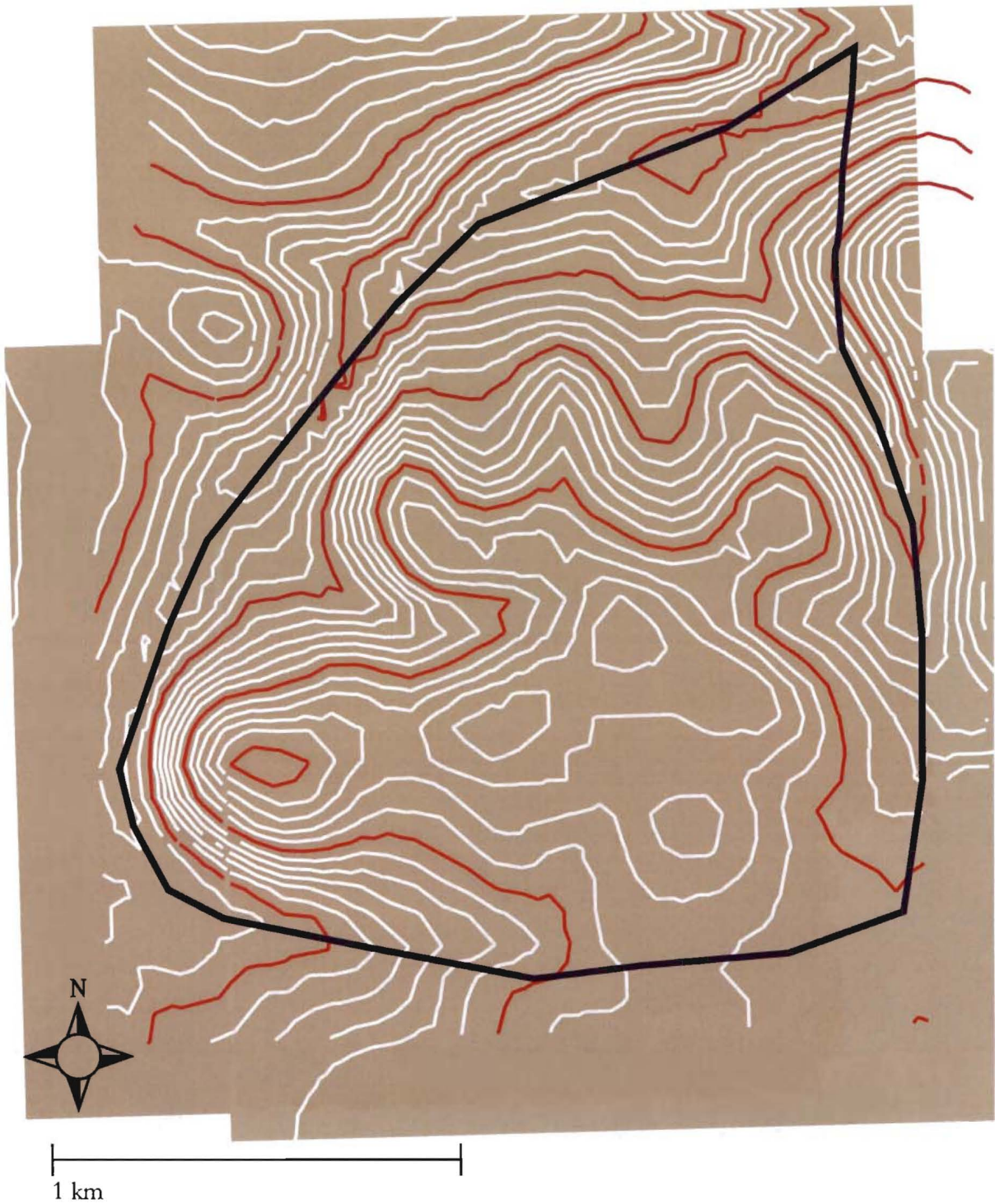


Figure 49: Topography Map, 5-meter topographic lines.

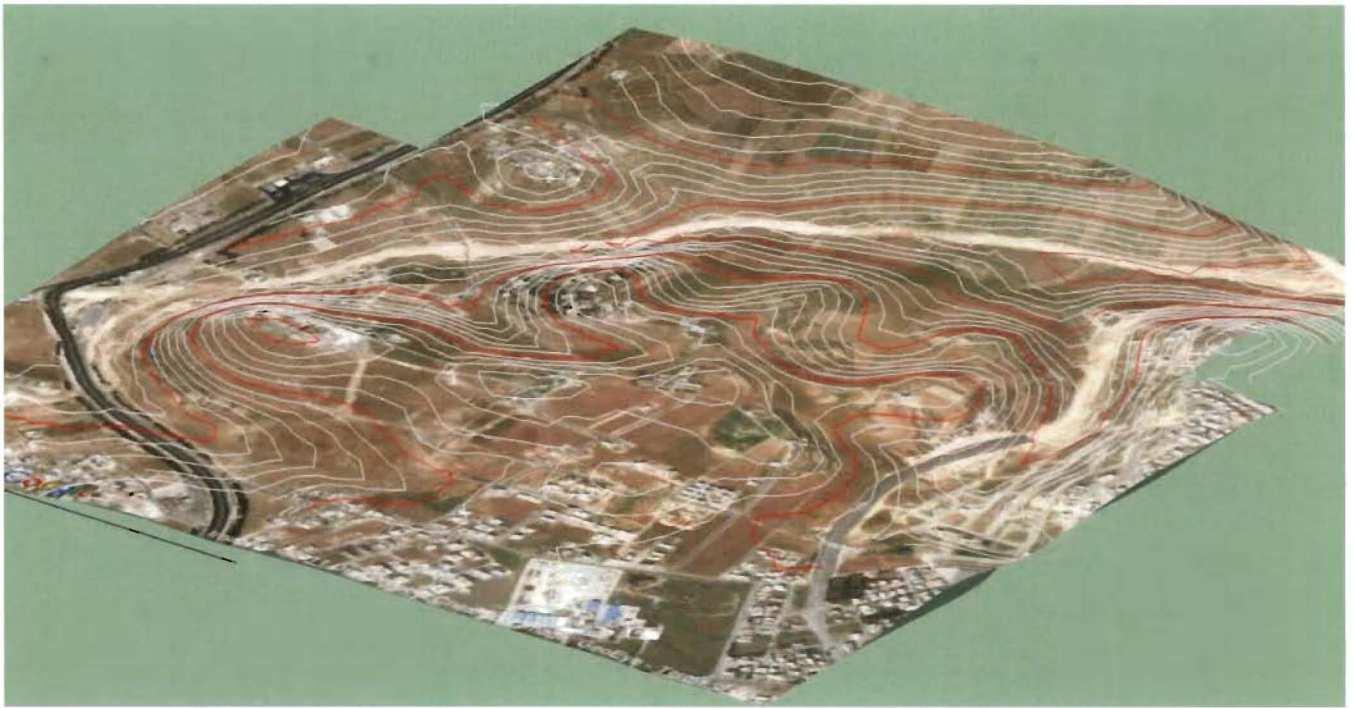


Figure 50: Topographic Model

site to be used as pasture. Likewise, some slopes are too steep to be farmed or used for construction, so these areas will also become vegetated buffer for the purpose of erosion control and wildlife habitat. All natural areas will be accessible to the community for recreation and respite.

and the plains on the southern edge of the site.

Because so much topographic change occurs on site, as can be seen in Figures 49 and 50, the form of the land must be carefully respected to avoid major earth-moving construction. The digital model and the topographic map, with 5-meter topographic lines, clearly show the four hilltops, the ridge through the plateau,



## Schematic Design and Development

As one examines the ideal locations for each type of desirable landscape, this schematic design begins to take form.

Many of the original roads are preserved, and already developed landscapes are the first places to be chosen for the community's neighborhoods.

Each area of developed lands is buffered by an area of

natural land, which serves as space for habitat, recreation, and water collection. The concept shown in [Figure 51: Conceptual Design](#) is an early look at how to organize the healthcare infrastructure.

It identifies areas for neighborhood development, but in this rendition there are too many clinics for just one community. The concept is further developed based on more concrete figures for population based on land use.

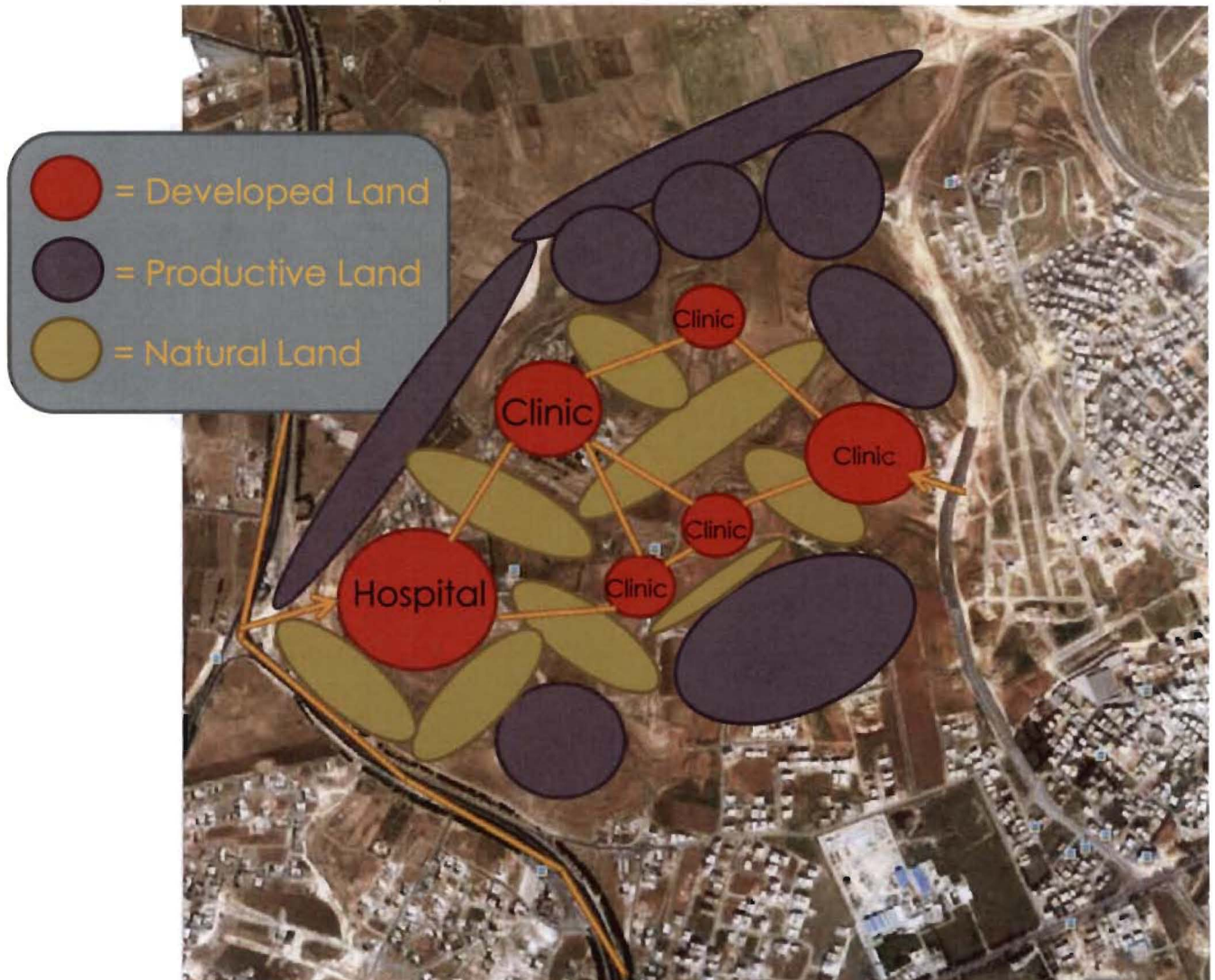


Figure 51: Conceptual Design

Legend:

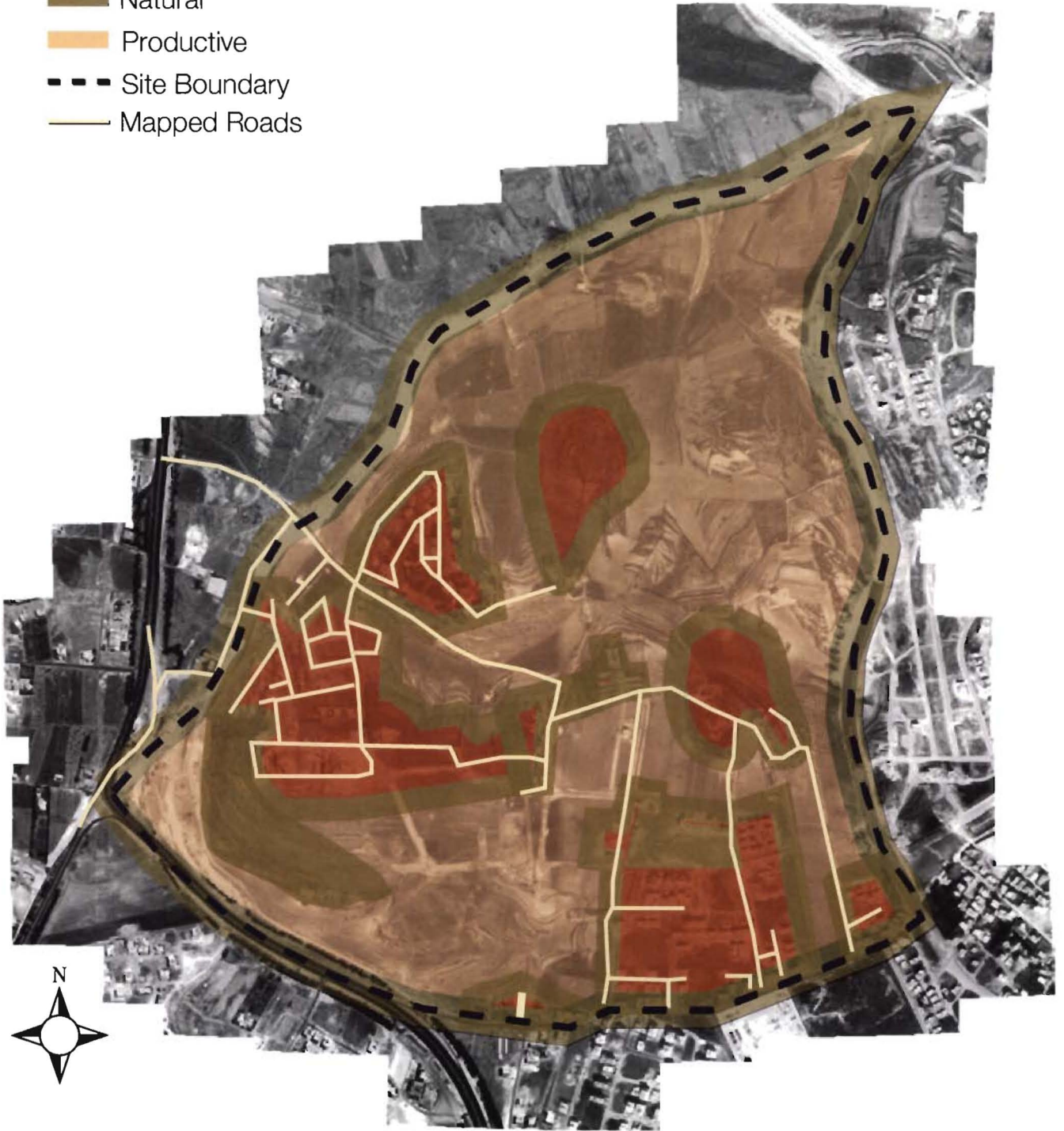
Developed

Natural

Productive

Site Boundary

Mapped Roads





## Master Plan

Following the schematic designs and the amount of land each household needs, four neighborhoods take form along the ridges. Figure 53: Master Plan shows that each neighborhood has a school/clinic (or the hospital) and at least one major amenity to the whole community. Spreading the amenities promotes equal status among each neighborhood. Decentralization of community services makes every

neighborhood important and valuable to the whole community. The “Big Neighborhood” uses the compact housing plan (Figure 55: Compact Housing Plan), giving the neighborhood a central, shared garden space. The other three neighborhoods use the alternate housing plans in addition to the compact housing plan (Figures 56-59). It should be noted that each neighborhood may use any combination of the two

housing types so long as the community remains eco-balanced. Plenty of natural vegetation protect waterways and slopes while providing food for the livestock.

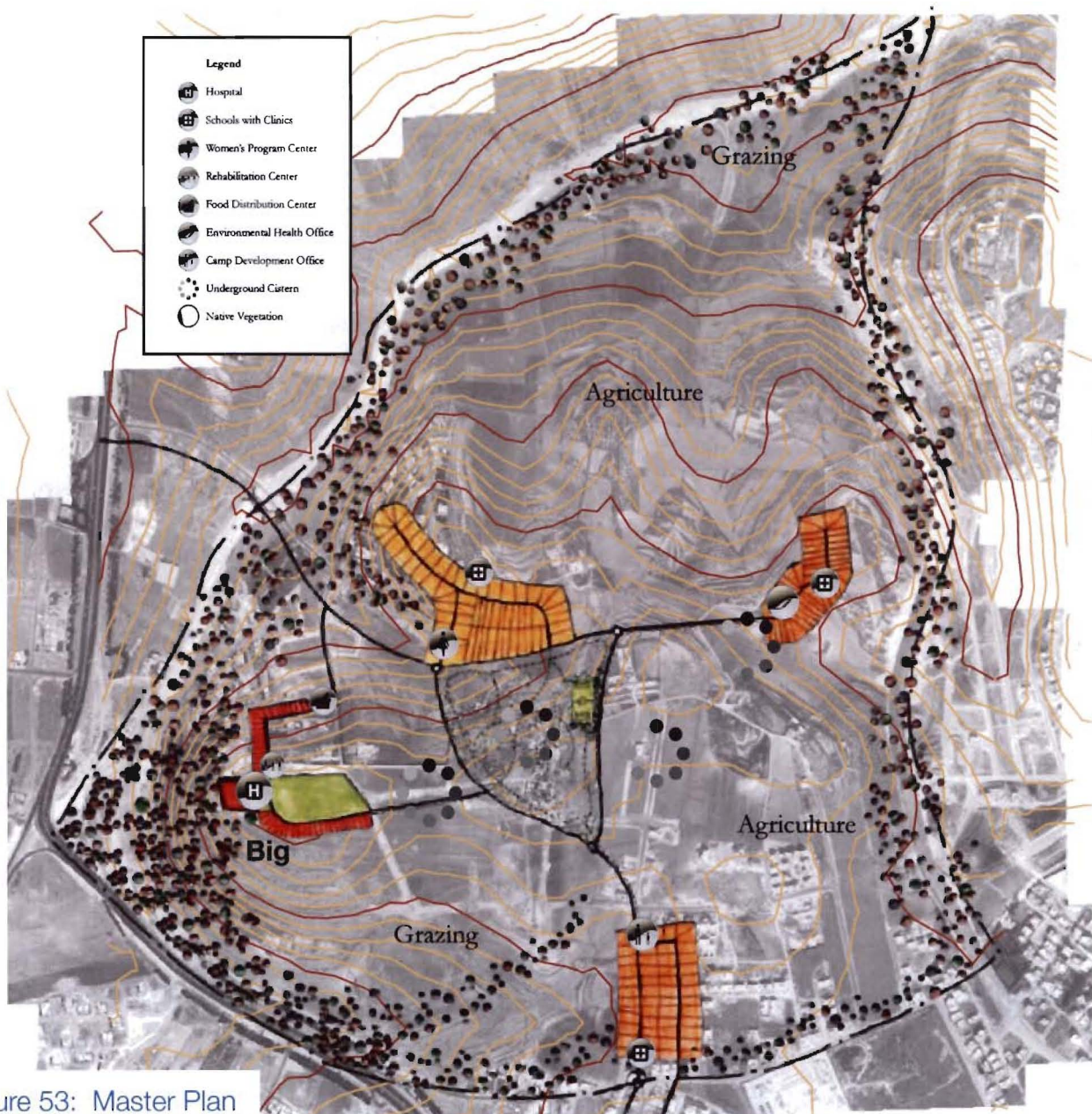


Figure 53: Master Plan





Figure 54: Detailed Master Plan

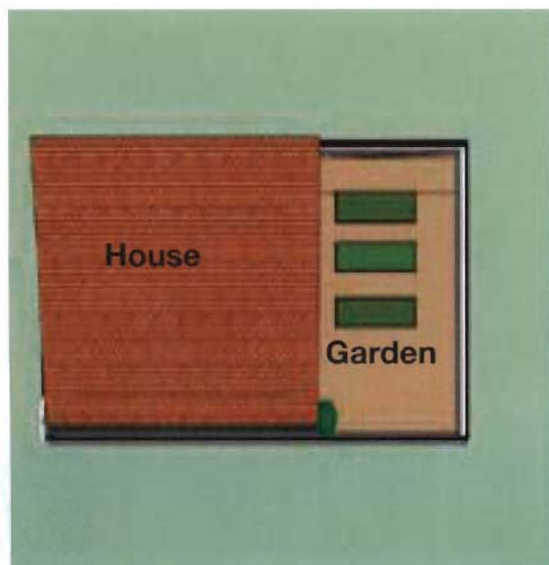


Figure 55: Compact Housing Plan

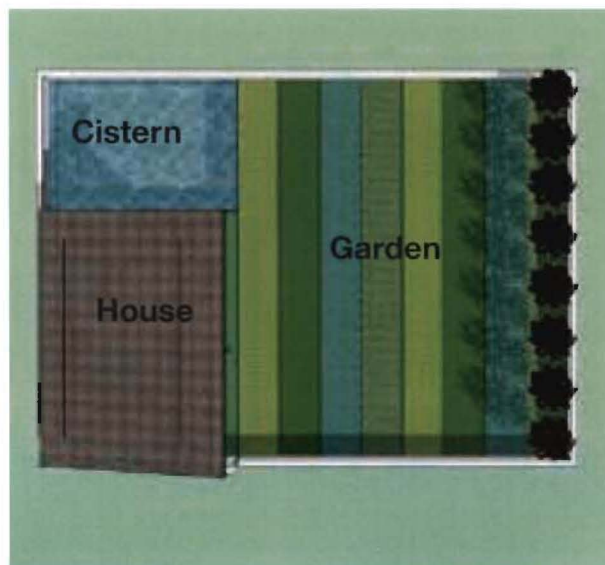


Figure 56: Alternate Housing Plan A

## Character Drawings

The Alternate Housing Plan A (Figure 57) incorporates the land needed to gather water for a family's domestic needs and provides a garden space, land for material harvesting, and space for the family's water cistern. This is the maximum proportion of land a family might receive for private use in the refugee camp.

The Compact Housing Plan (Figure 59) allows for denser communities by combining family garden into a central community garden. Families are allotted the same amount of land overall, but smaller parcels are allocated for private use. The advantages to this arrangement include closer communities and a neighborhood "park" and gathering space where the community garden produces food and community and cultural events could be held.

The Alternate Housing Plan B (Figure 58) is a compromise between the first two schemes. It has additional roof space and some room for a garden. The leftover family garden space is consolidated into the neighborhood garden, which doubles as a neighborhood park space.

These are just three of countless possibilities for individualizing and customizing based on the refugees' needs and preferences.



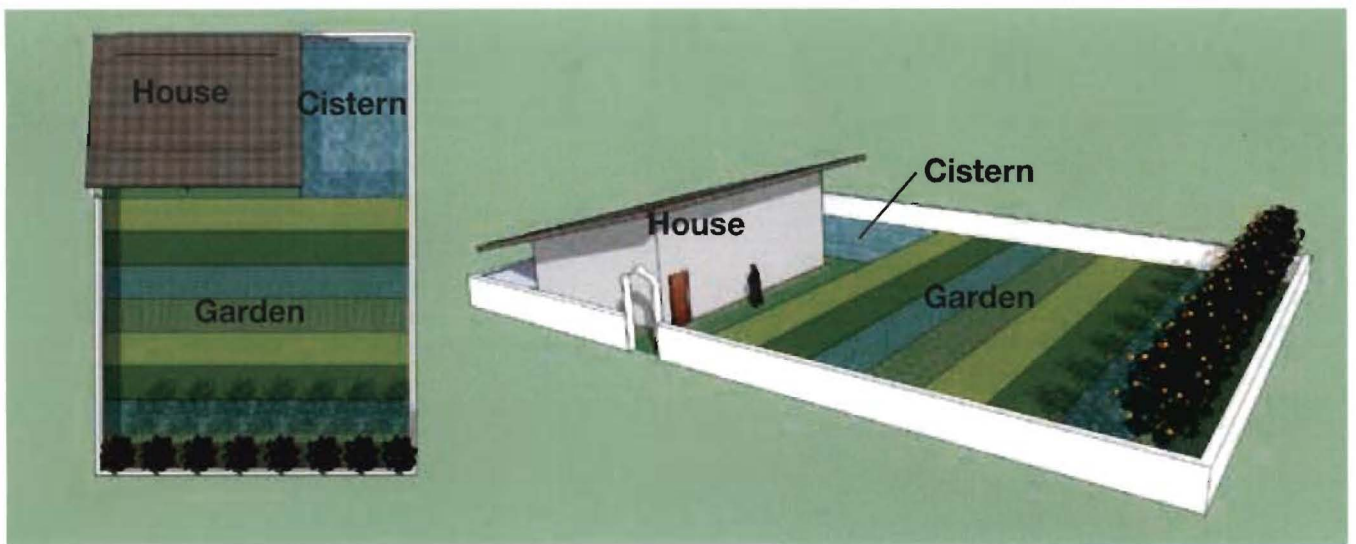


Figure 57: Alternate Housing Plan A

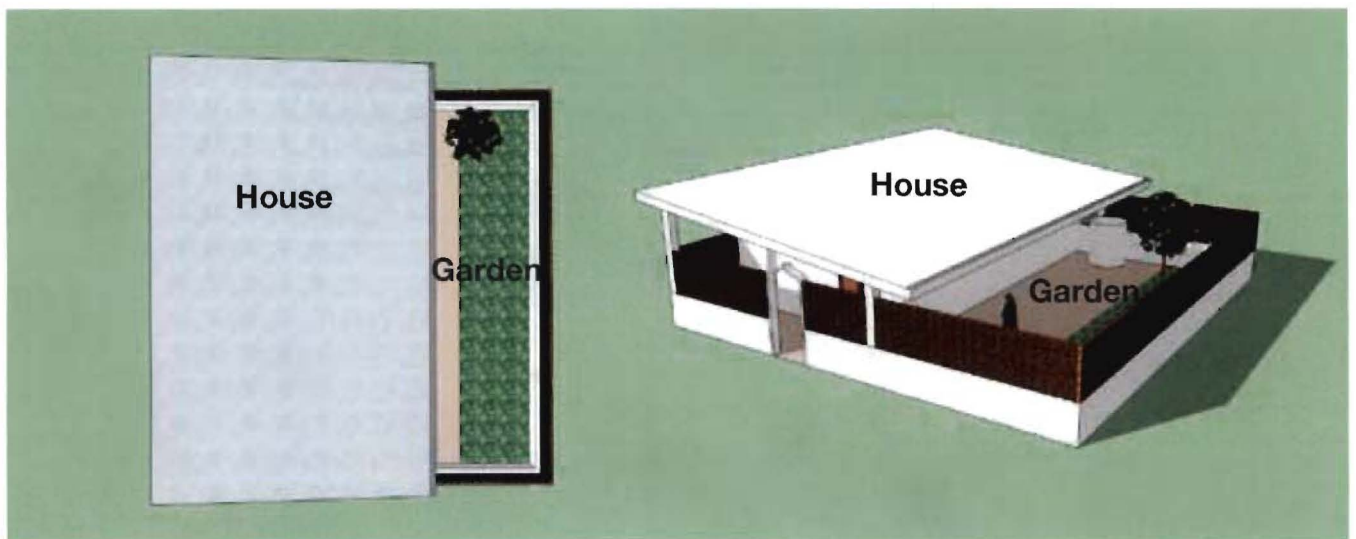


Figure 58: Alternate Housing Plan B

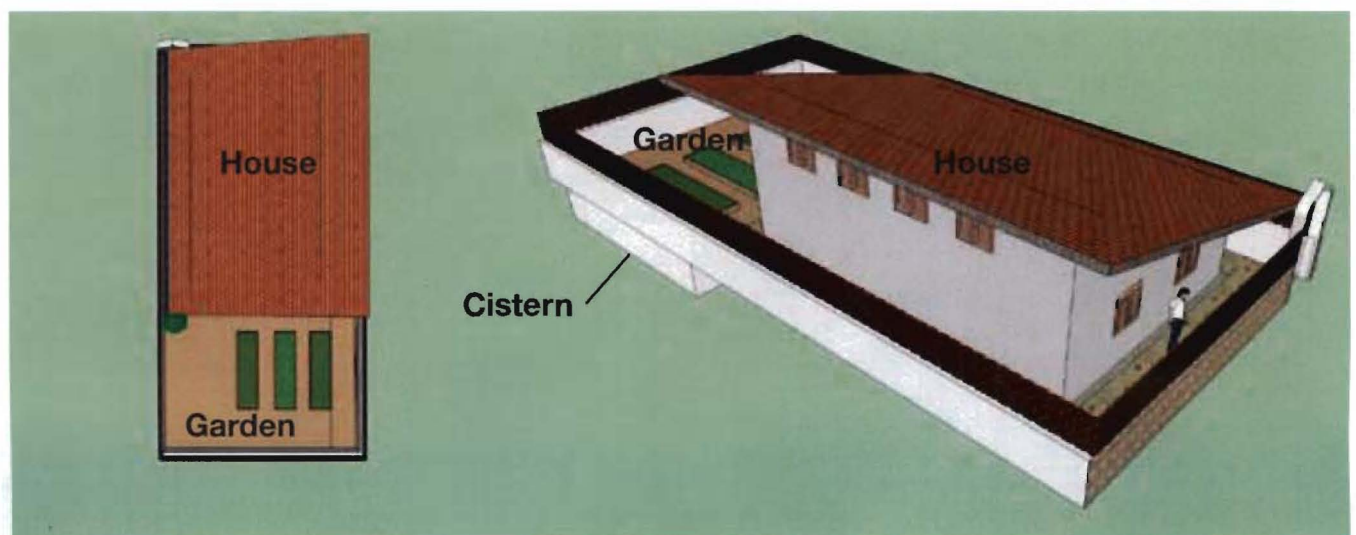


Figure 59: Compact Housing Plan



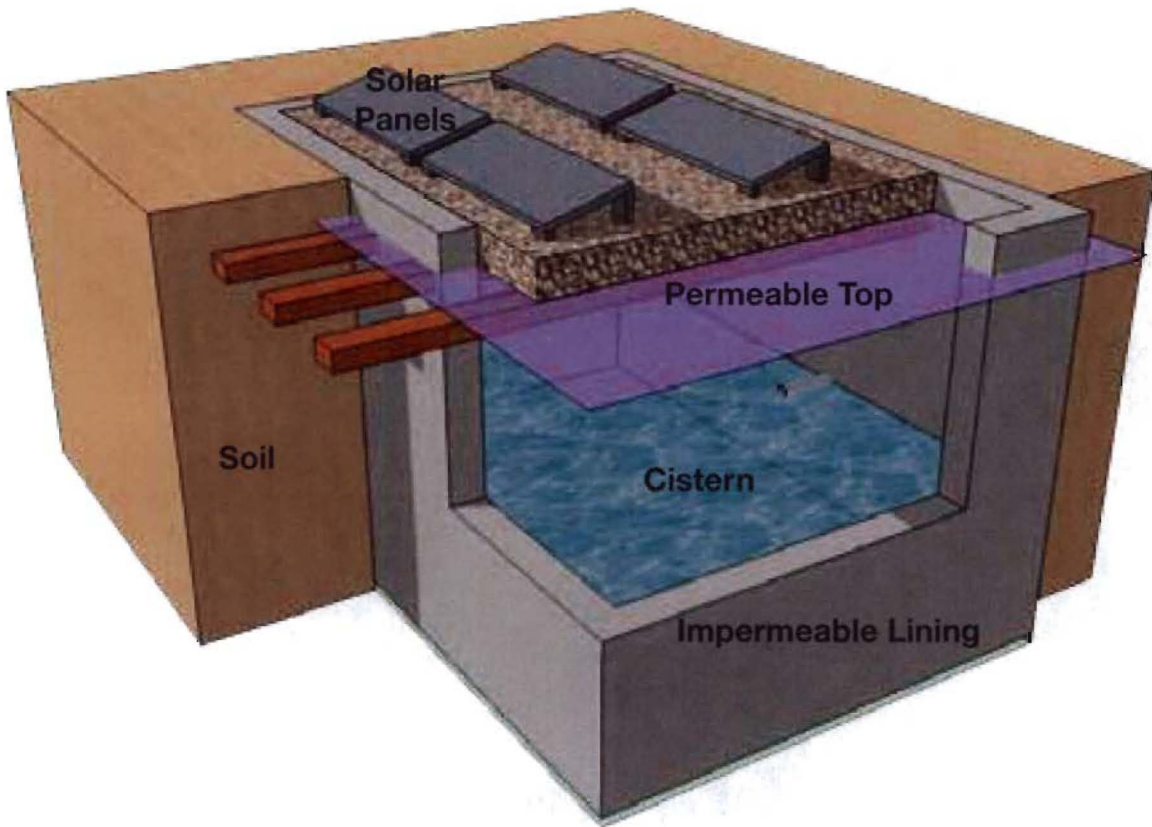


Figure 60: Underground Cistern Detail

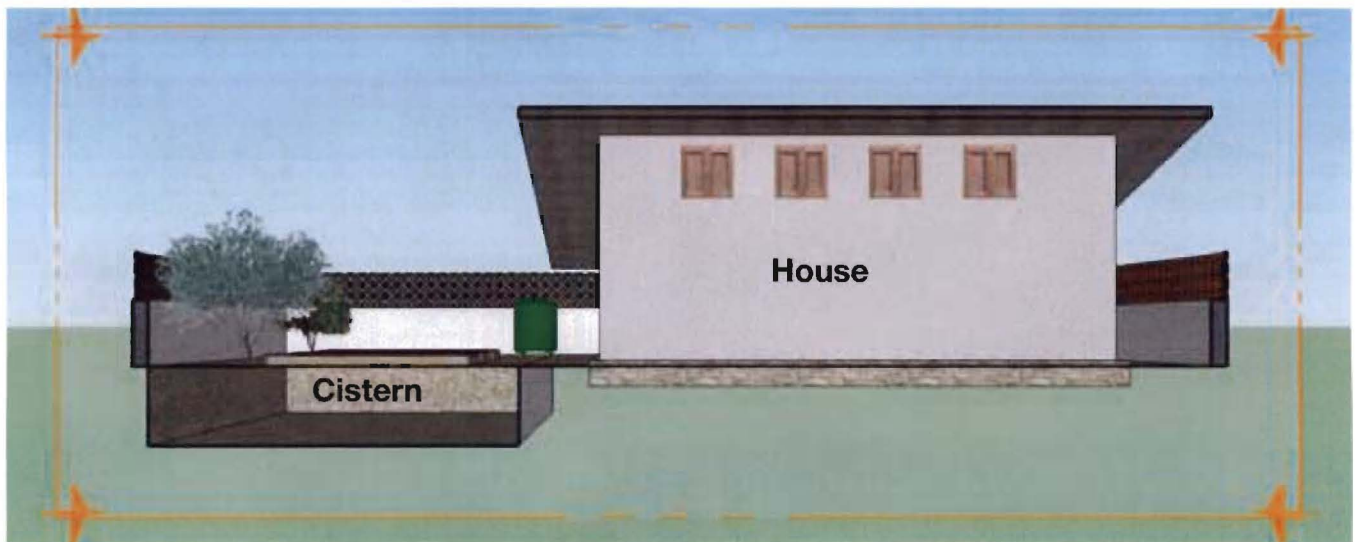


Figure 61: Family Unit Section

## Details

One of the advantages of using earth as a building material is that the excavated areas can then become underground water cisterns (Figure 60: Underground Cistern Detail). After the pit is completed, the walls are lined with clay or another sealant such as concrete. Posts span the opening, and filter fabric is stretched across to prevent large debris from contaminating the water. Then a layer of gravel and stones is placed on top of the fabric supported by the beams to provide a solid surface on which to mount solar panels. Cisterns located near the top of a hill naturally allow for flow of water into other areas of the community. Household cisterns, like the one shown in Figure 61: Family Unit Section, need to be pumped into the house, or the residents can draw water from them as they would a well.

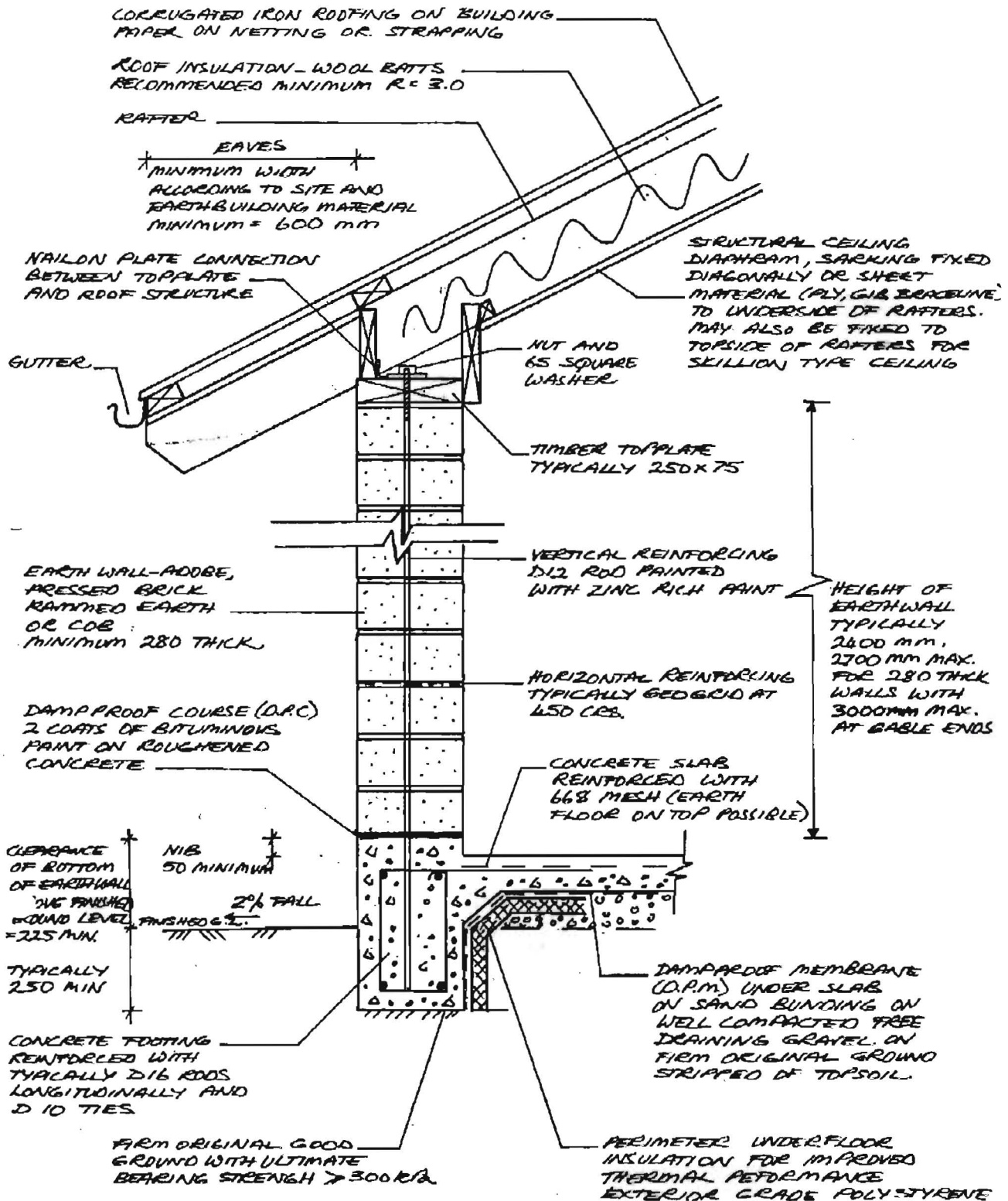
Buildings should be constructed primarily from on-site resources. Using soil, residents may choose between adobe brick (shown in Figure 62: Earthen Brick Wall Section) or rammed earth. Each offers strong insulation against heat and cold, and can be readily produced immediately upon arrival at the site.

Using soil resources allows for immediate rebuilding of homes and lives without the wait for aid agencies to

acquire, ship, and distribute building materials.

Figures 63-65 show what potential family units and neighborhoods might look like. The use of thick walls, reflective colors, water collection, solar panels, local materials, *mashrabiya* screens, and *paradeisos* gardens pull the community together to foster strong identity and sense of place.





#### NOTES

1. ALL DIMENSIONS IN MILLIMETRES
2. REFER TO NZ EARTHBUILDING STANDARDS  
NZS 4298 AND 4299 FOR SPECIFIC  
CONSTRUCTION DETAILS AND REQUIREMENTS

Figure 62: Reinforced Adobe Wall Section ("Adobe Wall Detail")



Figure 63: Private Garden



Figure 64: Entrance



Figure 65: Example Neighborhood



## Conclusions

This study has aimed to create a framework and example for a sustainable, healthy Palestinian refugee community in Jordan. While its goals are admirable, the results highlight just how challenging the situation really is.

In the model proposed, only 280 people would be served in a 307.5 hectare area. This is drastically below the densities of existing camps. While this lower density is more sustainable and environmentally responsible, it's probably not practical in an emergency situation. Most refugee gathering points and resulting settlements are more a result of convenience than the kind of actual in-depth planning that's proposed in this study. The amount of land needed to support a self-reliant refugee population near Amman, Jordan, is probably prohibitively expensive. Furthermore, the time needed to research and establish cultural profiles and local eco-balancing might delay much needed aid to struggling populations.

That's not to say the study hasn't produced valuable information, however. The study reveals an ideal to which aid workers might aspire. Even though refugee community density might not practically be reduced to a truly sustainable level, decreasing camp densities

would likely have a dramatic impact on a community's health and self-reliance. Incorporating more of the climate-appropriate technologies such as earthen construction, water harvesting and storing, and more space for community gardens would certainly have far-reaching, positive consequences. While the ideal numbers might be hard to attain, reaching for them will nonetheless influence better results in refugee communities.





## Glossary

**Camp Refugee:** a person who is registered with the United Nations under “refugee” status who lives in designated refugee communities.

**Disaster:** “a serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources” (Lizarralde 3).

**Eco-Balance:** The system by which land is allotted according to pressures human needs place on the natural environment.

**Reconstruction:** the process in which access to resources is restored to populations affected by disaster and pre-disaster conditions are improved.

**Refugees:** a group of people who have been displaced due to disaster in their home communities.

**Refugee Camp:** a secure area of land designated for refugees to receive healthcare, food, shelter, and water.

**Sustainability:** a system that promotes environmental, social, and economic benefits that can be continued—in theory—into eternity.

**United Nations High Commissioner for Refugees (UNHCR):** the United Nations organization charged with coordinating humanitarian relief to all refugees except the Palestinian refugees.

**United Nations Relief and Works Agency (UNRWA):** the United Nations executive body responsible for humanitarian efforts to assist Palestinian refugees.

**Vulnerability:** the elements of a community or society that make it susceptible to negative consequences of a disaster.





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Note: All images in this document and a digital version of the document have been provided on an accompanying flash drive.





